Respiratory and Allergic Health Effects of Dampness, Mold, and Dampness-Related Agents: A Review of the Epidemiologic Evidence

Mark J. Mendell, Anna G. Mirer, Kerry Cheung, My Tong, Jeroen Douwes

Supplemental Materials (Online)

Abbreviations

3-OH FA	3-hydroxy fatty acid
ß	estimated regression coefficient
BHR	bronchial hyperresponsiveness
CFU	colony forming unit
CI	confidence interval
dr	doctor
dx	diagnosed/diagnosis
ECP	eosinophil cationic protein
ECRHS	European Community Respiratory Health Survey
EPS	extracellular polysaccharide
EU	endotoxin unit
FEV1	forced expiratory volume in 1 second
FVC	forced vital capacity
HR	hyperresponsiveness
IgE	Immunoglobulin E
IOM	Institute of Medicine
IRR	incidence rate ratio
ISAAC	International Study of Asthma and Allergies in Childhood
LPS	lipopolysaccharide
mo	month
n	sample size
no.	number
OR	odds ratio
PASTURE	Protection Against Allergy Study in Rural Environments
PEFR	peak expiratory flow rate
POR	prevalence odds ratio

Qx	questionaire
RR	relative risk
se	standard error
SOB	shortness of breath
SPT	skin prick test
sx, sxs	symptom
TVOC	total volatile organic compound
VOC	volatile organic compound
w/o	without
WHO	World Health Organization

1. Epidemiologic findings included in IOM report

Summary of epidemiological studies evaluated in IOM report (2004)**, by category of health outcome on associations with "exposure to damp indoor environments or presence of mold or other agents in damp indoor environments" (Tables are adapted from tables 5.1–5.4, 5.6 and 5.8 in the IOM report)**

Table A1.1. Asthma development

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Population-based nested case-control studies				
(Jaakkola et al. 2002)	521 newly diagnosed adult cases; 932 controls	new doctor-diagnosed asthma	Visible mold or odor (work)	1.54 (1.01-2.32)
			Damp stains or paint peeling (work)	0.84 (0.56-1.25)
			Water damage (work)	0.91 (0.60-1.39)
			Visible mold or odor (home)	0.98 (0.68-1.40)
			Damp stains or paint peeling (home)	1.02 (0.73-1.41)
			Water damage (home)	0.90 (0.61-1.34)
(Thorn et al. 2001)	174 adults age 20-50 with asthma diagnosed in last 15 years; 870 referents	doctor-diagnosed asthma after age 16	Self-reported visible dampness at or before asthma dx	1.3 (0.9-2.0)

Table A1.1 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			Self-reported visible mold growth at or before asthma dx	2.2 (1.4-3.5)
			Self-reported dampness or visible mold growth at or before asthma dx	1.8 (1.1-3.1) prevalence
Children				
Nested and incident case-control studies				
(Oie et al. 1999)	172 children <2 years old with bronchial obstruction; 172 matched controls from population based sample of 3,754 newborns (same population as Nafstad)	bronchial obstruction	Surveyor-verified dampness	2.4 (1.25-4.44)
(Nafstad et al. 1998)	251 children < 2 years old with bronchial obstruction and 251 matched controls from population-based sample of 3,754 newborns	diagnosis of bronchial obstruction	Parent-reported dampness Inspector-observed dampness	2.5 (1.1-5.5) 3.8 (2.0-7.2)
(Yang et al. 1998b)	86 cases with a first-time diagnosis of asthma and 86 controls, age 3-15	asthma diagnosis	Parent-reported home dampness	1.77 (1.24-2.53)

Table A1.1 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Infante-Rivard 1993)	457 newly diagnosed infant cases and 457 controls, age 3-4	asthma diagnosis	Parent-reported humidifier use (not an indication of indoor dampness)	1.89 (1.30-2.74)
Cohort studies				
(Slezak et al. 1998)	1,085 children age 3-5 in Head Start programs	[ever] parental-reported, medically-diagnosed asthma	Parental-reported dampness or mold in prior 12 months	1.94 (1.23-3.04)
(Maier et al. 1997)	925 children age 5-9	parent-reported physician-diagnosed asthma [ever]	Water damage	1.7 (1.0-2.8)
			Other wetness/no water damage	1.1 (0.6-1.8)

Table A1.2 (cont.)

A1.2. Asthma symptoms in asthmatic people (=asthma exacerbation)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Cross-sectional studies				
(Zock et al. 2002)	18,872 adults from 38 centers of the European Community Respiratory Health Survey	current asthma	Self-reported water damage in last year	1.13 (0.95-1.35)
			Self-reported water on basement floor	1.54 (0.84-2.82)
			Self-reported mold or mildew in last year	1.28 (1.13-1.46)
(Kilpelainen et al. 2001)	10,667 college students age 18-25	current asthma symptoms	Self-reported visible mold	2.21 (1.48-3.28)
			Self-reported visible mold/ damp stains/water damage	1.66 (1.25-2.19)
(Engvall et al. 2001)	3,241 persons randomly sampled from multi-family buildings	asthma symptoms	At least one sign of dampness	2.28 (2.19-2.37)
			At least one dampness-related odor	2.38 (2.30-2.47)
			Reports of at least one odor & structural building dampness	3.59 (3.37-3.82)
(Hu et al. 1997)	2,041 young adults age 20-22	[ever] self-reported physician-diagnosed asthma	Self-reported water damage or leaking	1.6 (0.7-3.5)
			Self-reported indoor dampness	1.2 (0.8-1.9)
			Self-reported visible mold	1.5 (1.0-2.4)

Table A1.2 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		self-reported current asthma	Self-reported water damage or leaking	1.6 (0.7-3.8)
			Self-reported indoor dampness	1.3 (0.7-2.2)
			Self-reported visible mold	2.0 (1.2-3.2)
(Pirhonen et al. 1996)	1,460 adults age 25-64	[ever] self-reported asthma diagnosis	Self-reported damp or mold problem	1.02 (0.60-1.72)
(Brunekreef 1992b)	3,488 adult female parents of children age 6-12	[ever] doctor-diagnosed shortness of breath (asthma)	Self-reported damp stains or mold growth (last two years)	1.25 (0.94-1.66) among women
	3,184 adult male parents of children age 6-12			1.29 (0.92-1.81) among men
(Waegemaekers et al. 1989)	164 adult males	asthma	Self-reported damp homes	1.15 (non-significant)
	164 adult females		Self-reported damp homes	4.16 ($p<0.05$)
Case-Control Studies				
(Williamson et al. 1997)	102 asthmatics; 196 matched controls, age 5-44	physician diagnosed asthma	Self-reported dampness or condensation in present home	1.93(1.14-3.28)
			Self-reported dampness in previous home	2.55 (1.49-4.37)
			Observed severe dampness	2.36 (1.34-4.01)
			Observed significant mold	1.70 (0.78-3.71)
Children				
Cross-Sectional Studies				
(Wever-Hess et al. 2000)	113 infants age 0-1	any exacerbation of previously doctor-diagnosed asthma	Parental-reported damp housing	7.6 (2.0-28.6)

Table A1.2 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		recurrent exacerbations		3.8 (1.1-12.8)
(Taskinen et al. 1999)	622 children age 7-13; 28 cases total	symptomatic asthma	Self-reported dampness (school)	1.0 (0.4-2.3)
			Self-reported dampness (home)	1.9 (0.4-10.4)
			Self-reported dampness (school and home)	1.1 (0.2-5.5)
(Nicolai et al. 1998)	155 adolescents (mean age = 13.5 years)	5 asthma attacks in previous yr.	Past or present self-reported dampness in the home	61.5% exposed vs. 37.7% non-exposed ($p<0.05$)
(Ronmark et al. 1999)	3,431 children age 7-8 in northern Sweden	atopic asthma [ever]	Parent-reported dampness at home	1.40 (0.81-2.42)
		non-atopic asthma [ever]		1.78 (1.10-2.89)
(Yang et al. 1997b)	4,164 primary school children age 3-15	physician confirmed asthma	Parental-reported home dampness	1.73 (1.20-2.49)
(Jaakkola et al. 1993)	2,568 preschool children	current doctor-diagnosed asthma	Parental-reported water damage >1 year ago	2.52 (0.93-6.870
			Parental-reported mold odor in the past year	1.46 (0.34-6.29)
(Dales et al. 1991)	13,495 children age 5-8	parent-reported current doctor-diagnosed asthma	Parental-reported flood	1.29 (1.06-1.56)[1]
			Parental-reported moisture	1.58 (1.29-1.94) [1]
			Parental-reported dampness/mold	1.45 (1.23-1.71) [1]
			Parental reported mold site	1.40 (1.16-1.68) [1]
			Parental-reported mold sites (2 vs. 0)	1.67 (1.27-2.19) [1]

Table A1.2 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Dijkstra et al. 1990)	775 children age 6-12 years	Parent-reported attacks of shortness of breath or wheezing in past year	Parental-reported damp stains or mold	1.16 (0.38-3.52)
			Parental-reported damp stains and mold	1.56 (0.50-4.87)
(Brunekreef et al. 1989)	4,625 children age 7-12	[ever] doctor-diagnosed asthma	Parental-reported dampness (ever)	1.42 (1.04-1.94)
			Parental-reported mold or mildew (ever)	1.27 (0.93-1.74
(Waegemaekers et al. 1989)	190 children	[ever] doctor-diagnosed shortness of breath or asthma	Parental-reported damp homes	2.80 (0.39-20.02)
Case-Control Studies				
(Yazicioglu et al. 1998)	Children: 597 controls, 85 asthmatics	[current] doctor-diagnosed atopic asthma	Parental-reported home dampness	2.62 (1.13–6.81)
(Dekker et al. 1991)	13,495 children age 5-8	[current] parental-reported current doctor-diagnosed asthma	Parental-reported dampness or visible mold	1.46 (1.22-1.74)
(Mohamed et al. 1995)	77 child cases and 77 controls, age 9-11	[ever] asthma, defined as history of wheeze, doctor diagnosis, or decline in FEV1 after exercise)	Author-observed damp damage in child's bedroom	4.9 (2.0-11.7)

[1] unadjusted ORs reported, but said to be similar to adjusted ORs

A1.3. Dyspnea

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Cross-sectional studies				
(Koskinen et al. 1999b)	699 adults (16+ years) from 310 households	nocturnal dyspnea	Surveyor-assessed moisture	2.33 (1.09-4.98)
			Self-reported mold	1.58 (0.74-3.39)
	98 cases and 357 controls nested among Swedish adult cohort age 20-45	Daytime dyspnea	Self-reported water damage or flooding	2.2 (1.4-3.7)
			Dampness in the floor	3.1 (1.5-6.2)
			Visible mold on indoor surfaces	2.2 (1.2-4.0
		Nocturnal dyspnea	Self-reported water damage or flooding	2.2 (1.4-3.5)
			Dampness in the floor	2.7 (1.3-5.4)
			Visible mold on indoor surfaces	2.5 (1.4-4.5)
(Waegemaekers et al. 1989)	164 adult males	shortness of breath	Self-reported damp homes	9.38 (non-significant; no CI reported)
	164 adult females		Self-reported damp homes	2.25 (non-significant; no CI reported)
	190 children		Parental-reported damp homes	0.92 (0.32-2.61)
Children				
Cross-sectional studies				
(Jedrychowski and Flak 1998; Jedrychowski and Flak 1998)	1,129 children age 9	difficulty breathing	Parental-reported molds/dampness	2.01 (1.24-3.28)

A1.4. Wheeze

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adolescents and adults				
Cross-sectional studies				
(Gunnbjornsdottir et al. 2003)	1,853 young adults (age 20-44)	wheeze	Self-reported water damage or visible mold in home	1.4 (0.78-2.52)
(Zock et al. 2002)	18,872 adults from 38 centers of the European Community Respiratory Health Survey	wheezing and breathlessness	Self-reported water damage in last year	1.16 (1.00-1.34)
			Self-reported water on basement floor	1.46 (1.07-2.01)
			Self-reported mold or mildew in last year	1.34 (1.18-1.51)
		wheezing apart from colds	Self-reported water damage in last year	1.23 (1.06-1.44)
			Self-reported water on basement floor	1.26 (0.81-1.98)
			Self-reported mold or mildew in last year	1.44 (1.30-1.60)
(Nicolai et al. 1998)	155 adolescents (mean age = 13.5 years)	night-time wheeze	Parental-reported dampness	14.3% exposed vs. 5.3% (unadjusted p = 0.06)
			Parental-reported dampness (adjusted for mite allergen levels)	5.77 (1.17-28.44)
(Brunekreef 1992b)	3,488 adult female parents of children age 6-12	wheeze	Self-reported damps stains or mold growth (last two years)	1.43 (1.15-1.77) in women
	3,184 adult male parents of children age 6-12			1.63 (1.30-2.06) in men

Table A1.4 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Waegemaekers et al. 1989)	164 adult males	wheeze	Self-reported damp homes	4.06 ($p < 0.01$; no CI reported)
	164 adult females	wheeze	Self-reported damp homes	4.79 ($p < 0.01$; no CI reported)
	190 children	wheeze [wheeze or shortness or breath or asthma]	Parental-reported damp homes Culturable airborne fungal spore concentrations	2.80 (1.18-6.64) 1.28 [no CI]
Case-control studies				
(Norbäck et al. 1999)	98 cases and 357 controls nested among Swedish adult cohort age 20-45	wheeze	Self-reported water damage or flooding	1.6 (1.03-2.6)
			Dampness in the floor	2.8 (1.4-5.5)
			Visible mold on indoor surfaces	2.4 (1.4-4.3)
			Moldy odor	1.5 (0.74-3.1)
			At least one sign of dampness	2.2 (1.5-3.2)
Infants and children				
Cross-sectional studies				
(Belanger et al. 2003)	849 infants with asthmatic siblings*	wheeze	Reported persistent mold or mildew in the previous 12 mo.	2.51 (1.37-4.62) mother has asthma 1.22 (0.80-1.88) mother w/out asthma
			Airborne total fungal spores, Burkard sampler, ORs per 20 spores (no additional information provided)	1.23 (1.01-1.49) mother has asthma 1.10 (0.99-1.23) mother w/out asthma
(Gent et al. 2002)	880 infants age 1-12 mo with asthmatic siblings	wheeze	Concentations (CFU/m^3) of culturable airborne mold identified to genus, with levels compared to 0 = undetectable: 1-499 CFU/m^3 = low	

Table A1.4 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			500-499 CFU/m^3 = medium >= 1,000 CFU/m^3 = high	
			Penicillium	RRs =
			- low	1.11 (0.87-1.42)
			- medium	1.29 (0.65-1.48)
			- high	2.15 (1.34-3.46)
			Cladosporium	RRs =
			- low	0.92 (0.69-1.22)
			- medium	0.95 (0.61-1.49)
			- high	0.91 (0.53-1.56)
			Other mold	RRs =
			- low	0.97 (0.75-1.26)
			- medium	0.91 (0.49-1.68)
			- high	1.02 (0.49-2.11)
			Water leaks	RR = 1.18 (0.90-1.55)
			Humidifier use	RR = 1.41 (1.11-1.79)
(Park et al. 2001)	499 infants with at least one parent with asthma or allergy	any wheeze	Family room dust endotoxin level ≥100 EU/mg	1.33 (0.99-1.79)
		repeated wheeze		1.55 (1.00-2.42)
(Taskinen et al. 1999)	622 children age 7-13; 76 cases total	wheezing symptoms	Parental-reported dampness (school)	3.8 (1.8-8.3)
			Parental-reported dampness (home)	3.4 (0.8-14.2)
			Parental-reported dampness (school and home)	3.8 (1.3-11.3)
(Jedrychowski and Flak 1998)	1,129 children age 9	wheezing	Parental-reported molds/dampness	1.63 (1.07-2.48)
(Rylander et al. 1998)	347 children from 2 schools (one with previous mold problem)	wheezing	Problem school vs. control school	13.5% vs. 2.8% (p = 0.014) among nonatopics 36.4% vs. 13.3% (p = NS) among atopics
(Slezak et al. 1998)	1,085 children age 3-5	wheezing in last 12 mo	Parental-reported dampness or	2.01 (1.38-2.93)

Table A1.4 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
	in Head Start programs		mold in prior 12 mo	
(Maier et al. 1997)	925 children age5-9	wheezing in past 12 mo	Parental-reported mold	1.2 (0.7-1.9)
			Parental-reported water damage	1.7 (1.0-2.8)
			Parental-reported basement water	1.0 (0.6-1.7)
			Parental-reported water condensation	1.3 (0.8-2.1)
			Any of the above	1.1 (0.7-1.8)
(Jaakkola et al. 1993)	2,568 preschool children	persistent wheezing	Parental-reported mold odor in the past year	4.31 (1.61-11.6)
			Parental-reported water damage >1 year ago	8.67 (3.87-19.4)
(Dales et al. 1991)	13,495 children age 5-8	wheeze	Parental-reported dampness/mold	1.58 (1.42-1.76)
			Parental-reported flood	1.25 (1.10-1.41)
			Parental-reported moisture	1.74 (1.53-1.98)
			Parental reported mold site	1.42 (1.26-1.59)
			Parental-reported mold sites (2 vs. 0)	1.73 (1.45-2.06)
(Dijkstra et al. 1990)	775 children age 6-12	wheeze	Parental-reported damp stains or mold	1.13 (0.45-2.88)
			Parental-reported damp stains and mold	1.54 (0.59-4.00)
(Strachan et al. 1990)	1,000 children age 7	wheeze in past yr	Parental-reported mold	3.70 (2.22-6.15)
(Brunekreef et al. 1989)	4,625 children age 7-12	wheeze	Parental-reported molds (ever)	1.79 (1.44-2.32)
			Parental-reported dampness (ever)	1.23 (1.10-1.39)

*Same population studied by Gent et al., 2002

Table A1.5 (cont.)

A1.5. Cough

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Cross-sectional studies				
(Gunnbjornsdottir et al. 2003)	1,853 young adults	long-term cough	Self-reported water damage or visible mold in home (n=74)	2.23 (1.24-4.00)
(Engvall et al. 2001)	3,241 adults living in multifamily buildings	current cough	Self-reported moldy odor and signs of high humidity	3.97 (3.74-4.22)
			Self-reported moldy odor and major water leakage	3.78 (3.46-4.12)
(Koskinen et al. 1999b)	699 adults (16+ years) from 310 households	nocturnal cough	Surveyor-assessed moisture	2.11 (1.21-4.98)
		for cough w/o phlegm		1.42 (0.92-2.19)
		for cough with phlegm		1.15 (0.78-1.69)
		nocturnal cough	Self-reported mold	2.30 (1.32-4.01)
		cough w/o phlegm		1.60 (1.01-2.53)
		cough with phlegm		1.44 (0.95-2.19)
(Thorn and Rylander 1998)	129 adults age 18-83	dry cough	Airborne **(1□3)**-ß-D-**glucan (**while disturbing settled dust)	
			--	1.05 (0.72-1.52)
			>2-4 ng/m^3	1.08 (0.74-1.56)
			(>4 ng/m^3	
(Pirhonen et al. 1996)	1,460 adults age 25-64	cough	Self-reported damp or mold problem	1.37 (0.99-1.88)

Table A1.5 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Brunekreef 1992b)	3,488 adult female parents of children age 6-12	cough	Self-reported damps stains or mold growth (last two years)	1.75 (1.30-2.36) among women
	3,184 adult male parents of children age 6-12			2.56 (1.94-3.38) among men
(Waegemaekers et al. 1989)	164 adult males	cough	Self-reported damp homes	1.35 (non-significant; no CI reported)
	164 adult females	cough	Self-reported damp homes	3.48 (non-significant; no CI reported)
	190 children	morning cough	Parental-reported damp homes	2.99 (1.28-6.97)
		day/night cough	Parental-reported damp homes	1.54 (0.77-3.10)
		Cough	Culturable airborne fungal spore concentrations	1.98 (no CI reported)
Children				
Cross-sectional studies				
(Belanger et al. 2003)	593 infants with asthmatic sibling	persistent cough	Reported persistent mold or mildew in the previous 12 mo.	1.53 (1.01-2.30)
			Airborne total fungal spores, Burkard sampler, ORs per 20 spores (no additional information provided)	0.99 (0.89-1.10)
	256 infants with asthmatic sibling + asthmatic mother		Reported persistent mold or mildew in the previous 12 mo.	1.91 (1.07-3.42)
			Airborne total fungal spores, Burkard sampler, ORs per 20 spores (no additional	1.04 (0.87-1.24)

Table A1.5 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			information provided)	
(Gent et al. 2002)	880 infants age 1-12 months with asthmatic siblings	persistent cough	Concentations (CFU/m^3) of culturable airborne mold identified to genus, with levels compared to 0 = undetectable: 1-499 CFU/m^3 = low 500-499 CFU/m^3 = medium >= 1,000 CFU/m^3 = high	
			Penicillium	RRs =
			- low	1.01 (0.80-1.28)
			- medium	1.62 (0.93-2.82)
			- high	2.06 (1.31-3.24)
			Cladosporium	RRs =
			- low	1.02 (0.79-1.35)
			- medium	1.45 (0.99-2.12)
			- high	0.72 (0.42-1.24)
			Other mold	RRs =
			- low	1.05 (0.83-1.33)
			- medium	0.78 (0.42-1.45)
			- high	1.18 (0.63-2.21)
			Water leaks	RR = 1.17 (0.91-1.49)
			Humidifier use	RR = 1.26 (1.01-1.56)
(Dales and Miller 1999)	403 elementary school children	nocturnal cough or wheeze	Parental-reported mold or mildew	1.28 (0.74-2.23)
(Koskinen et al. 1999a)	204 children (≤15 yrs) from 310 households	nocturnal cough	Surveyor-assessed moisture	5.72 (1.22-26.83)
		cough w/o phlegm		3.23 (1.43-7.31)
		cough with phlegm		0.94 (0.47-1.87)
(Taskinen et al. 1999)	622 children age 7-13 101 cases total	cough	Parental-reported dampness (school)	2.3 (1.3-4.1)

Table A1.5 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			Parental-reported dampness (school and home)	4.7 (2.1-10.8)
(Andriessen et al. 1998)	1,614 children age 5-13	cough	Parental reported moisture stains	1.01 (0.89-1.16)
			Parental reported molds	1.01 (0.87-1.18)
(Jedrychowski and Flak 1998; Jedrychowski and Flak 1998)	1,129 children, age 9	chronic cough	Parental-reported molds/dampness	1.13 (0.64-2.02)
(Rylander et al. 1998)	347 children from 2 schools (one with previous mold problem)	dry cough	Problem school vs. control school	26.1% vs. 10.3% (p = 0.024) - nonatopics 54.5% vs. 7.1% (p = 0.003) -atopics
		dry cough at night w/out cold		23.1% vs. 8.2% (p = 0.012) - nonatopics 58.3% vs. 6.5% (p < 0.001) -atopics
		cough w/ phlegm		17.0% vs. 7.5% (p = NS) - nonatopics 40.0% vs. 7.1% (p = 0.031) -atopics
(Austin and Russell 1997)	1,537 children age 12-14	cough	Parental reported damp	1.62 (1.06-2.48)
			Parental reported mold	1.78 (1.10-2.89)
(Jaakkola et al. 1993)	2,568 preschool children	persistent cough	Parental-reported mold odor in the past year	3.88 (1.88-8.01)
			Parental-reported water damage >1 year ago	2.54 (1.16-5.57)
(Dales et al. 1991)	13,495 children age 5-8	cough	Parental-reported dampness/mold	1.89 (1.63-2.20)

Table A1.5 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			Parental-reported flood	1.38 (1.16-1.65)
			Parental-reported moisture	1.91 (1.60-2.27)
			Parental reported mold site	1.61 (1.36-1.89)
			Parental-reported mold sites (2 vs. 0)	2.26 (1.80-2.83)
(Dijkstra et al. 1990)	775 children age 6-12	cough	Parental-reported damp stains or mold	0.57 (0.13-2.56)
			Parental-reported damp stains and mold	3.62 (1.57-8.36)
(Brunekreef et al. 1989)	4,625 children age 7-11	cough	Parental-reported molds (ever)	2.12 (1.64-2.73)
			Parental-reported dampness (ever)	2.16 (1.64-2.84)
Case-control studies				
(Verhoeff et al. 1995)	Children age 6-12	chronic cough	Parental-reported dampness	1.70 (0.94-3.09)
	84 chronic cough cases;		Parental-reported mold	1.90 (1.02-3.52)
	246 controls		Surveyor-observed dampness	1.18 (0.70-1.99)
			Surveyor-observed mold	1.26 (0.70-2.25)

Table A1.6 (cont.)

A1.6. Upper respiratory tract symptoms

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Cross-sectional studies				
(Engvall et al. 2002)	3,241 adults living in multi-family buildings	nasal symptoms	Self-reported moldy odor and water leakage in past 5 years	1.92 (1.78-2.07)
		throat irritation		4.42 (4.09-4.77)
	10,667 students (18-25 years)	allergic rhinitis	Self-reported visible mold	1.29 (1.01-1.66)
		common cold ≥4 times per year		1.48 (1.17-1.88)
		allergic rhinitis	Self-reported visible mold/ damp stains/water damage	1.30 (1.12-1.51)
		common cold ≥4 times per year		1.28 (1.09-1.47)
(Wan and Li 1999)	1,113 workers in 19 office buildings	nasal congestion/runny nose	Self-reported mold	0.94 (0.50-1.77)
			Self-reported flooding	1.55 (0.79-3.06)
(Wieslander et al. 1999)	95 staff members from 4 hospitals	for irritated, stuffy or runny nose	Measured dampness in concrete floor	1.10 (1.02-1.18)
(Koskinen et al. 1999b)	699 adults (16+ years) from 310 households	rhinitis	Surveyor-assessed moisture	1.06 (0.71-1.59)
		sinusitis		1.92 (1.11-3.30)
		sore throat		1.46 (1.03-2.08)
		rhinitis	Self-reported mold	1.89 (1.15-3.11)
		sinusitis		1.36 (0.78-2.39)
		sore throat		2.40 (1.56-3.69)

Table A1.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Thorn and Rylander 1998)	129 adults age 18-83	irritation in the nose	Airborne **(1□3)**-ß-D-**glucan (**while disturbing settled dust) --	
			>2-4 ng/m^3	1.23 (0.85-1.77)
			>4 ng/m^3	0.98 (0.68-1.43)
(Pirhonen et al. 1996)	1,460 adults age 25-64	dry or sore throat	Self-reported damp or mold problem	1.68 (0.97-2.89)
(Brunekreef 1992b)	3,488 adult female parents of children age 6-12	allergy	Self-reported damps stains or mold growth (last two years)	1.03 (0.79-1.35) among women
	3,184 adult male parents of children age 6-12			1.24 (0.95-1.73) among men
Children				
Cross-sectional studies				
(Rylander and Megevand 2000)	304 children age 4-5	cold	Parental-reported humidity	2.71 (1.07-6.91)
		sore throat		3.02 (1.14-7.98)
		cold	Parental-reported mold at home	2.27 (.082-6.33)
		sore throat		2.57 (0.86-7.71)
(Zacharasiewicz et al. 2000)	18606 children aged 6 to 9 years in Upper Austria	atopic rhinitis (running, obstructed, or itchy nose without a cold in the last year	Parental-reported dampness at home	1.51 (1.31-1.74)
(Dales and Miller 1999)	403 elementary school children	itchy eyes, skin rash or itch, nose irritation	Parental-reported mold or mildew	1.81 (1.02-3.24)
(Koskinen et al. 1999a)	204 children (≤15 yrs) from 310 households	rhinitis	Surveyor-assessed moisture	4.31 (1.80-10.34)
		sinusitis.		0.75 (0.19-2.98)
		sore throat		2.34 (1.13-4.86)
(Jaakkola et al. 1993)	2,568 preschool children	nasal congestion	Parental-reported mold odor in the past year	2.39 (1.15-4.98)
		nasal excretion		2.38 (1.13-4.99)

Table A1.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		nasal congestion	Parental-reported water damage >1 year ago	4.60 (2.57-8.22)
		nasal excretion		3.19 (1.64-6.190)
(Brunekreef et al. 1989)	4,625 children age 7-11	hay fever	Parental-reported molds (ever)	1.57 (1.31-1.87)
			Parental-reported dampness (ever)	1.26 (1.06-1.50)

2. Findings not included in IOM review on associations of health outcomes with dampness, mold, or agents associated with dampness

A2.1. Asthma development

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Prospective studies				
(Matheson et al. 2005)	845 adults age 20-45 from the southeastern suburbs of Melbourne	doctor-diagnosed asthma	Ergosterol in floor dust[a]	1.50 (0.68-3.30)
			Total fungi, culturable airborne[a]	0.89 (0.60-1.34)
			Cladosporium, culturable airborne[a]	0.96 (0.72-1.27)
			Other fungi, culturable airborne[a]	0.99 (0.73-1.36
Retrospective studies				
(Gunnbjornsdottir et al. 2006)	15,995 subjects age 20-44 from Iceland, Norway, Denmark, Sweden, and Estonia who had participated in the European Community Respiratory Health Survey (ECRHS I)	asthma onset	Damp homes	1.13 (0.92-1.40)
Cross-sectional studies				
(Park et al. 2008)	200 adults in 3 respiratory case groups and 152 asymptomatic employees in a water-damaged office building in northeastern US	current asthma with post-occupancy dr dx	total culturable fungi in floor dust in total fungi models	1.46 (0.88 to 2.44)
			total culturable fungi in chair dust in total fungi models	1.60 (0.99 to 2.58)
			ergosterol in floor dust in total fungi models	1.22 (0.71 to 2.11)

Table A2.1 (cont'd)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			ergosterol in chair dust in total fungi models	1.48 (0.82 to 2.67)
			endotoxin in floor dust in total fungi models	1.05 (0.53 to 2.08)
			endotoxin in chair dust in total fungi model	0.87 (0.51 to 1.48)
			hydrophilic fungi in floor dust in hydrophilic fungi models	2.09 (1.15 to 3.79)
			hydrophilic fungi in chair dust in hydrophilic fungi models	1.79 (1.12 to 2.85)
			ergosterol in floor dust in hydrophilic fungi models	1.19 (0.68-2.07)
			ergosterol in chair dust in hydrophilic fungi models	1.47 (0.81 to 2.63)
			endotoxin in floor dust in hydrophilic fungi models	1.02 (0.51 to 2.05)
			endotoxin in chair dust in hydrophilic fungi models	0.87 (0.51 to 1.47)
(Cox-Ganser et al. 2009)	1,171 workers in sentinel cases hospital or nearby control hospital in western U.S.	Post-hire onset dr-dx asthma, from occupant questionnaire	Dampness score from researcher observation, range 0-20: 0-2 3-5 6-20 Airborne --fungi, bacteria, and endotoxin Floor and chair dust - endotoxin, beta-glucan, ergosterol, culturable fungi, culturable bacteria, ECP *Pen/Asp*	Positive dose response: 1.0 approx 1.6 approx 2.2 ($p<0.5$) no significant associations
Children				
Prospective studies				
(Jaakkola et al. 2005)	1,916 children age 1-7 in Espoo, Finland	asthma development	Mold odor	IRR=2.44 (1.07-5.60)

Table A2.1 (cont'd)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			Visible mold	IRR=0.65 (0.24-1.72)
			Moisture in the surfaces	IRR=0.92 (0.54-1.54)
			Water damage	IRR=1.01 (0.45-2.26)
(Ronmark et al. 2002)	3,431 children age 7-8 in northern Sweden	ever asthma, incident in prior 12 mo	parent-reported dampness at home	1.13 (0.63-2.03)
(Iossifova et al. 2009)	483 children age 3, born to atopic parent from Cincinati	Recurrent wheezing in children with atopy at age 3	low mold/water damage = moldy odor or visibile mold or water damage area < 0.2 m^2 (versus no odor, mold, or water damage), from home inspection at age 8 mo	1.86 (0.86 to 4.00)
			high mold/water damage = visibile mold or water damage area ≥ 0.2 m^2, from home inspection at age 8 mo	6.16 (1.38 to 27.44)
			(1-3)-ß-D-glucan (ug/g) in settled dust at age 8 mo – ORs are for the top of each quartile compared to the bottom of that quartile --	
			first quartile	
			second quartile	
			third quartile	
			fourth quartile	
			(estimated ORs for the top of each quartile relative to the bottom of the first quartile are: 1.91, 1.85, 1.48, 0.70)	1.91 (0.18-20.56) 0.97 (0.72-1.31) 0.80 (0.54-1.18) 0.47 (0.13-1.71)
			endotoxin in dust, interquartile range	1.37 (0.86-2.19)
		Asthma Predictive Index at age 3	low mold/water damage	1.68 (0.96 to 2.94)
			high mold/water damage	7.08 (2.22 to 12.60)
			(1-3)-ß-D-glucan (ug/g) in settled	3.44 (0.50-23.52)

Table A2.1 (cont'd)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			dust at age 8 mo – ORs are for the top of each quartile compared to the bottom of that quartile -- first quartile second quartile third quartile fourth quartile (estimated ORs for the top of each quartile relative to the bottom of the first quartile are: 3.44, 4.95, 4.50, 2.74)	1.14 (0.87-1.50) 0.91 (0.70-1.17) 0.61 (0.24-1.59)
			endotoxin in dust, interquartile range	1.37 (0.96-1.96)
Retrospective studies				
(Pekkanen et al. 2007)	362 children with asthma age 12-84 months	new asthma diagnosis	Any suspected moisture damage in whole home	0.63 (0.28-1.45)
			Area of water damage in whole home	1.01 (0.98-1.05)
			Visible mold in whole home	1.24 (0.73-2.11)
			Some mold odor in whole home	1.35 (0.42-4.36)
			Clear mold odor in whole home	4.12 (0.65-26.01)
			Minor or major moisture-damage, main living area	2.24 (1.25-4.01)
			Minor moisture-damage, main living area	2.11 (1.06-4.21)
			Major moisture-damage, main living area	2.46 (1.09-5.55)
			Maximum severity (1-2) moisture damage, main living area	2.75 (1.40-5.40)
			Maximum severity (2+) moisture damage, main living area	4.04 (1.60-10.20)
			Area of damage m^2	1.36 (0.91-2.03)
			Mold growth, mold spots, main living area	4.01 (1.12-14.32)
			Mold growth, visible mold, main	1.95 (0.69-5.47)

Table A2.1 (cont'd)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			living area	
			Visible mold, main living area	2.59 (1.15-5.85)
			Mold odor, main living area	2.96 (0.62-14.19)
			Minor or major moisture-damage, kitchen	1.41 (0.80-2.47)
			Visible mold, kitchen	1.13 (0.63-2.04)
			Minor or major moisture-damage, bathroom	0.70 (0.39-1.25)
			Visible mold, bathroom	0.81 (0.44-1.49)
			Minor or major moisture-damage, other interior spaces	0.77 (0.40-1.46)
			Visible mold, other interior spaces	0.86 (0.37-2.00)
			Moisture damage in child's bedroom	1.97 (1.00-3.90)
Cross-sectional studies				
(Hyvarinen et al. 2006)	36 children with new asthma and 36 control children, age 12-84 months	newly diagnosed asthma (new dx, or at least 2 attacks of wheezing per dr)	LPS in home floor dust, per 0.01 nmol/mg	0.75 (0.40-1.42)
			3-OH fatty acids in home floor dust (C-10), per 0.01 nmol/mg	0.81 (0.50-1.33)
			3-OH fatty acids in home floor dust (C-12), per 0.01 nmol/mg	0.72 (0.42-1.24)
			3-OH fatty acids in home floor dust (C-14), per 0.01 nmol/mg	0.93 (0.51-1.69)
			3-OH fatty acids in home floor dust (C-16), per 0.01 nmol/mg	0.98 (0.59-1.64)
			culturable mesophilic bacteria in home floor dust, per 10E5 cfu/g	1.01 (0.99-1.03)
			culturable mesophilic actinomycetes in home floor dust, per 10E3 cfu/g	1.18 (0.99-1.42)
			ergosterol in home floor dust, per 10E3 pg/mg	1.12 (0.97-1.30)
			culturable mesophilic fungi in home floor dust, per 10E5 cfu/g	1.08 (0.95-1.23)

Table A2.1 (cont'd)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			culturable xerophilic fungi in home floor dust, per 10E5 cfu/g	1.11 (0.94-1.31)

[a] Effect of doubling allergen or fungal exposure on the risk of developing new clinical outcomes
IRR = Incidence Rate Ratio

A2.2. Asthma symptoms in asthmatics (asthma exacerbation)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Children				
Intervention studies				
(Kercsmar et al. 2006)	62 symptomatic, asthmatic children age 2-17	Acute care visits in 12-month follow-up period	Thorough remediation of indoor dampness and mold	
		Proportion with 1+ visit		17.2% vs. 36.4% in controls (p=0.15)
		Average number visits		0.28 vs. 0.91 in controls (p=0.06)
		Acute care visits in 6-month post-remediation period		
		Proportion with 1+ visit		3.5% vs 33.3% in controls (p=0.003)
		Average number visits		0.07 vs. 0.52 in controls (p=0.004)
(Bernstein et al. 2006)	19 mold-sensitized asthmatic children age 5-17 with home ventilation systems	Pulmonary function – difference in PEFR variability between intervention and control (negative = improvement)	Ultraviolet radiation intervention to reduce microbial exposures over a two week period	-0.068, p=0.03

Table A2.2 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		Pulmonary function – difference in FEV1		-0.87, p=0.32
		difference in wheezing severity score.		-0.02, p=0.4
		difference in shortness of breath severity score		-0.22, p=0.04
		difference in chest tightness severity score.		-0.3, p=0.04
		difference in cough severity score.		-0.28, p=0.26
		difference in days with wheeze		-0.25, p=0.24
		difference in days with shortness of breath		-2.75, p=0.02
		difference in days with chest tightness		-3.50, p=0.04
		difference in days with cough		-2.00, p=0.28
		difference in medication use (no of inhalations).		-38, p=0.04
Prospective studies				
(Wever-Hess et al. 2000)	257 children age 0-4, with doctor-diagnosed asthma	for "exacerbation"	Damp housing	7.6 (2.0-28.6)
		for "recurrent exacerbations"		3.8 (1.1-12.8)
(Turyk et al. 2006)	61 children age 3-13 with asthma	number of asthma	*Penicillium* in bedroom air	

Table A2.2 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		symptoms	Tertile 1	1.0
			Tertile 2	0.8 (0.2-2.8)
			Tertile 3	3.8 (1.0-14.4)
				P-value, trend over tertiles = 0.09
				P-value, linear trend = 0.06
		frequent asthma symptoms	*Penicillium* in bedroom air	
			Tertile 1	1.0
			Tertile 2	1.2 (0.4-4.4)
			Tertile 3	4.9 (1.2-20.2)
				P-value, trend over tertiles = 0.04
				P-value, linear trend = 0.01
		number of asthma symptoms	*Total fungi* in bedroom air	
			Tertile 1	1.0
			Tertile 2	1.1 (0.3-3.7)
			Tertile 3	1.1 (0.3-3.6)
				P-value, trend over tertiles = 0.92
				P-value, linear trend = 0.48
		frequent asthma symptoms	*Total fungi* in bedroom air	
			Tertile 1	1.0
			Tertile 2	0.8 (0.2-2.8)
			Tertile 3	1.3 (0.4-4.5)
				P-value, trend over tertiles = 0.71
				P-value, linear trend = 0.16
Cross-sectional studies				
(Bonner et al. 2006)	149 children age 3-5 with asthma	for "no. of hospitalizations in	Moisture or mildew	3.31 (1.62-6.75)

Table A2.2 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		prior 12 months"		
		for "no. of times wheezing in prior 12 months"		3.25 (1.8-6.0)
		for "no. of nights awake in prior 2 weeks"		2.19 (1.40-3.41)
(Forsberg et al. 1997)	15,962 children age 6-12 in Sweden, Finland and Norway	for "asthma attacks"	Moisture stains or molds, current exposure	1.2 (0.9-1.5)
			Moisture stains or molds, during the child's first 2 years	1.6 (1.3-2.1)
(Sotir et al. 2003)	128,568 middle school children in 7th and 8th grades in North Carolina	upper respiratory infection-triggered wheezing with asthma risk factor among children reporting current wheezing	Mold/mildew in home	POR = 1.72 (1.48-2.01)
(Hagmolen of Ten Have et al. 2007)	526 asthmatic children, median age 11	presence of severe airway HR (meth chall)	damp stains or mold growth, in living room or bedroom, in last 2 years, from parental qx	3.95 (1.82-8.57)
		>3 symptomatic days (total score of cough, wheeze, SOB from diary)		1.74 (0.74-4.11)
Infants, Adults, and Children				
Intervention Studies				
(Burr et al. 2007)	182 current asthmatics age 3-61 with indoor mold in South Wales	perceived medication use in last 6 months -- estimated difference in proportion improving, intervention vs.	controlled intervention -- visible mold removal plus fungicide and installation of ventilation fan	0-6 mo: 59% (35 to 81); 0-12 mo: 6% (-15 to 27)

Table A2.2 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		controls		
		perceived preventer use in last 4 weeks – difference in proportion improving		0-6 mo: 20% (2 to 37); 0-12 mo: 19% (4 to 35)
		perceived reliever use in last 4 weeks – difference in proportion improving		0-6 mo: 2% (-12-17); 0-12 mo: 18% (2 to 33)

POR = Prevalence Odds Ratio

A2.3. Asthma ever

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Cross-sectional studies				
(Nriagu et al. 1999)	693 adults in South Africa	asthma	Home dampness	1.91 (0.61-6.01)
(Dales et al. 1991)	14,799 parents of school-aged children age 5-8 in six regions of Canada	asthma	Dampness/mold	1.56 (1.25-1.95)
(Skorge et al. 2005)	2,401 adults age 26-82 in Hordaland County, Norway	"asthma ever"	Mold, only earlier	1.4 (0.68-2.85)
			Mold, earlier and last year	1.5 (0.69-3.47)
			Water damage, only earlier	1.4 (0.78-2.62)
			Water damage, earlier and last year	1.2 (0.49-2.85)
(Pirhonen et al. 1996)	1,460 adults age 25-64	ever (self-reported) dr dx asthma	dampness or mold	1.02 (0.60-1.72)
Children				
Prospective studies				
(Douwes et al. 2006)	696 children with atopic mothers	"doctor-diagnosed asthma"	Glucan	
			medium	0.63 (0.27-1.48)
			high	0.70 (0.30-1.60)
			Extracellular polysaccharides-*Aspergillus*/*Penicillium*,	
			medium	0.78 (0.40-1.55)
			high	0.42 (0.18-0.99)
(Ponsonby et al. 2000)	7,241 children age 7 in Tasmania	Parent-reported ever asthma at age 7	Mold observed by interviewer in baby's bedroom at home visit at age 1 month	1.26 (0.87-1.81)
			Mother reported mold found inside house, excluding bathroom, at age 1 month	1.20 (0.96-1.51)
Cross-sectional studies				

Table A2.3 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Tsai et al. 2006)	2,290 5th grade children in Taipei, Taiwan	Physician-diagnosed asthma, ever	parental reported leaking water/standing water at home	1.22 (0.76-1.96)
		Suspected asthma		1.50 (1.02-2.19)
		Physician-diagnosed asthma, ever	parental reported visible mold on walls or furniture	1.14 (0.52-2.50_
		Suspected asthma		1.21 (0.64-2.28)
(Lawson et al. 2005)	2,038 school children in Grades 1 to 6	"asthma"	Presence of home mold or dampness	1.54 (1.20-1.97)
			Home mold or dampness, Swift Current[a] boys	0.97 (0.53-1.79)
			girls	0.64 (0.31-1.31)
			Home mold or dampness, Estevan[a], boys	1.70 (0.98-2.94)
			girls	1.76 (1.01-3.07)
(Yang et al. 1998a)	330 primary school children age 6-12 in Kaohsiung rural areas in Taiwan. 165 cases and 165 controls	asthma	Home dampness	2.65 (1.52-4.62)
(Dong et al. 2008a)	10,784 children age 6-13 from urban areas in northeast China	dr-dx asthma	mold in the past 12 mo (signs of flooding, water damage or mold growth in the home)	1.54 (1.22 to 1.94)
(Bornehag et al. 2005)	10,851 preschool children age 1-6 in Sweden	dr dx asthma	water leakage	1.28 (1.04-1.58)
			floor moisture	1.39 (1.00-1.93)
			visible dampness	2.14 (1.09-4.24)
			condensation	1.50 (1.16-1.94)
(Dong et al. 2008b)	3,945 children age 1-6 from kindergartens in northeast China	dr-dx asthma	mold in past 12 mo (signs of flooding, water damage, or mold growth in home; from parental qx)	1.56 (1.13-2.16)
(Jedrychowski and Flak 1998; Jedrychowski and Flak 1998)	1,129 children age 9 attending 14 Cracow schools	dx asthma	Parental-reported molds/dampness	2.65 (0.96-7.13)
(Lee et al. 2003)	32,497 school children age 6-15 in Taiwan	dr dx asthma	water damage	Boys 0.92 (0.71-1.17) Girls 1.33 (1.02-

Table A2.3 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
				1.70)
			visible mold	Boys 1.27 (1.10-1.47)
				Girls 1.20 (1.01-1.41)
(Maier et al. 1997)	925 children age 5-9	dr dx asthma	household water damage	1.7 (1.0-2.8)
			mold growth, basement water, or routine water condensation on walls/windows	1.1 (0.6-1.8)
(Ronmark et al. 1999)	School children age 7-8 in northern Sweden: 3,431	asthma ever	parental-reported dampness at home	1.54 (1.10-2.14)
	2,149 skin tested children	non-atopic asthma ever	parental-reported dampness at home	1.78 (1.10-2.89)
	2,149 skin tested children	atopic asthma ever	parental-reported dampness at home	1.40 (0.81-2.42)
(Gehring et al. 2008)	840 children, ages 9-12 yr old, from five European countries	asthma ever	endotoxin concentration in living room floor dust, per interquartile range	0.44 (0.07-2.94)

[a] Swift Current and Estevan are two communities located in Southern Sasketchewan
RR= Relative Risk

A2.4. Current asthma

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Prospective studies				
(Matheson et al. 2005)	845 adults age 20-45from the southeastern suburbs of Melbourne	attack of asthma in the last 12 months"	Ergosterol in floor dust[a]	0.92 (0.59-1.44)
			Total fungi, culturable airborne[a]	1.54 (0.98-2.43)
			Cladosporium, culturable airborne[a]	1.52 (1.08-2.13)
			Other fungi, culturable airborne[a]	1.23 (0.92-1.66)
Cross-sectional studies				
(Dharmage et al. 2001)	485 Participants in a follow-up study to the European Community Respiratory Health Survey (ECRHS)	bronchial hyperreactivity only	Levels of *Cladosporium* in the highest quartile	8.5 (1.6-44.3) for
			Levels of *Penicillium* in the highest quartile	3.9 (1.1-14.3)
(Gunnbjornsdottir et al. 2006)	15,995 subjects age 20-44 from Iceland, Norway, Denmark, Sweden, and Estonia who had participated in the European Community Respiratory Health Survey (ECRHS I)	asthma	Water damage	1.18 (0.95-1.44)
			Wet floors	1.67 (1.22-2.27)
			Visible molds	1.53 (1.18-1.98)
			Any dampness	1.27 (1.06-1.52)
(Skorge et al. 2005)	2,401 adults age 26-82 in Hordaland County, Norway /	asthma	Mold, only earlier	1.4 (0.68-2.85)
			Mold, earlier and last year	1.4 (0.78-2.62)
			Water damage, only earlier	1.4 (0.78-2.62)
			Water damage, earlier and last year	1.2 (0.49-2.85
(Zock et al. 2002)	18,873 people from 38 study centres from the ECRHS	current asthma	Water damage in last year	1.13 (0.95-1.35)

Table A2.4 (cont.)

		bronchial responsiveness		1.15 (0.97-1.35)
		current asthma	Water on basement floor	1.54 (0.84-2.82)
		bronchial responsiveness		1.05 (0.71-1.55)
		current asthma	Mold or mildew in last year	1.28 (1.13-1.46)
		bronchial responsiveness		1.14 (1.01-1.29)
(Park et al. 2008)	200 adults in 3 respiratory case groups and 152 asymptomatic employees in a water-damaged office building in northeastern US	epidemiologic asthma (current asthma with post-occupancy dr dx and 3 or more asthma-like sxs)	total culturable fungi in floor dust in total fungi models	1.55 (1.05 to 2.27)
			total culturable fungi in chair dust in total fungi models	1.57 (1.08 to 2.25)
			ergosterol in floor dust in total fungi models	1.54 (1.02 to 2.34)
			ergosterol in chair dust in total fungi models	1.46 (0.96 to 2.23)
			endotoxin in floor dust in total fungi models	1.07 (0.64 to 1.80)
			endotoxin in chair dust in total fungi model	0.83 (0.57 to 1.21)
			hydrophilic fungi in floor dust in hydrophilic fungi models	1.62 (1.06 to 2.48)
			hydrophilic fungi in chair dust in hydrophilic fungi models	1.57 (1.11 to 2.23)
			ergosterol in floor dust in hydrophilic fungi models	1.55 (1.02 to 2.36)
			ergosterol in chair dust in hydrophilic fungi models	1.46 (0.96 to 2.22)
			endotoxin in floor dust in hydrophilic fungi models	1.10 (0.66 to 1.84)
			endotoxin in chair dust in hydrophilic fungi models	0.88 (0.61 to 1.26)

Table A2.4 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Norbäck et al. 1999)	98 cases and 357 controls nested among Swedish adult cohort, age 20-45	current asthma (BHR + 1+ asthma sx in last yr)	1+ dampness factor	2.2 (1.5-3.2)
			dampness in floor	3.3 (1.6-6.8)
			moldy odor	1.8 (0.9-3.8)
			visible mold	2.9 (1.6-5.3)
			water damage or flood	1.9 (1.2-2.9)
Children				
Cross-sectional studies				
(Simoni et al. 2005)	20,016 children (mean age 7 years)	Children, current asthma	Mold/dampness – never	1.00
			current only	1.39 (1.00-1.93)
			early only (1st yr of life)	1.80 (1.41-2.30)
			both current and early	1.17 (0.80-1.71)
	13,266 adolescents (mean age 13 years)	Adolescents, current asthma	Mold/dampness – never	1.00
			current only	1.28 (0.90-1.82)
			early only (1st yr of life)	1.89 (1.38-2.59)
			both current and early	1.62 (1.00-2.62)
(Tavernier et al. 2006)	105 asthmatic children and 95 non-asthmatic children	asthma	Parental-reported dampness in kitchen and bathroom	2.72 (0.50-14.8)
			Parental-reported absence of dampness in home**	0.36 (0.14-0.91)
(Yang et al. 1997a)	4,164 primary school children age 6-12 in Kaohsiung rural areas in Taiwan	asthma	Home dampness	1.68 (1.16-2.43)
(Yang et al. 1997b)	4,164 primary school children age 6-12 in Kaohsiung rural areas in Taiwan	asthma	Home dampness	1.73 (1.20-2.49)
(Forsberg et al. 1997)	15,962 children age 6-12 in Sweden, Finland, and Norway	asthma treatment	Moisture stains or molds, current exposure	0.9 (0.7-1.2) for
			Moisture stains or molds, during the child's first 2 years	2.0 (1.6-2.6) for

Table A2.4 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Spengler et al. 2004)	5,951 children age 8-12 in 8 Russian cities	current doctor-diagnosed asthma	Water damage	1.37 (0.69-2.70)
			Presence of molds	2.82 (1.63-4.88)
(Wickens et al. 1999)	474 children aged 7 to 9 years who participated in the International Study of Asthma and Allergies in Childhood (ISAAC)	asthma	Mold	12.99 (2.63-64.19)
(Dales and Miller 1999)	403 Canadian elementary school children	asthma	*Aspergillus*, culturable in dust	0.92 (0.35-2.44)
			Alternaria, culturable in dust	1.90 (0.55-6.59)
			Cladosporium , culturable in dust	0.46 (0.18-1.21)
			Epicoccum, culturable in dust	0.88 (0.30-2.57)
			Yeast, culturable in dust	2.16 (0.73-6.39)
			Ergosterol, airborne	1.3 (0.6-2.8)
(Li and Hsu 1996) 1996)	1,340 children age 8-12 in the Taipei area	asthma	Parental-reported dampness	1.25 (0.81-1.95)
			Dampness	1.18 (0.70-1.98)
			Mold	1.18 (0.70-1.98)
			Stuffy odor	1.05 (0.66-1.66)
			Water damage	1.95 (0.80-4.76)
			Flooding	0.94 (0.50-1.74)
(Nafstad et al. 2005)	942 children age 3-5 in Oslo, who attend daycare centres	asthma	Dampness problems	0.76 (0.40-1.42)
(Peters et al. 1999)	3,676 Southern Californian children	current asthma	Water damage	1.27 ($p \geq 0.15$)
			Mildew	1.17 ($p \geq 0.15$)
(Dong et al. 2008a)	10,784 children age 6-13 from urban areas in northeast China	current asthma	mold in the past 12 mo (signs of flooding, water damage or mold growth in the home)	1.69 (1.15 to 2.48)
(Dong et al. 2008b)	3,945 children age 1-6 from kindergartens in northeast China	current asthma	mold in past 12 mo (signs of flooding, water damage, or mold growth in home; from parental qx)	1.89 (1.22-2.94)
(Hagerhed-Engman et al. 2009)	198 cases and 202 controls chosen through 2 qxs from children age 3-8 in Sweden	dr-dx asthma	severe moldy odor in home and/or at least 1 room, from inspection	0.57 (0.27 to 1.26)
			severe moldy odor along the skirting board in at least 1 room, from inspection	1.28 (0.60 to 2.73)

Table A2.4 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			severe visible spots of mold, stain of dampness or discolored stains on walls & ceiling in at least 1 room, from inspection	0.28 (0.5 to 1.52)
(Li and Hsu 1997)	46 children age 7-15 with dx asthma	current dr dx asthma	dampness	1.46 (0.55-3.85)
			mold	1.02 (0.39-2.69)
			water damage	0.70 (0.27-1.86)
			stuffy odor	3.19 (1.08-9.42)
			flooding	1.18 (0.27-5.17)
			any dampness or mold indicator	1.01 (0.34-3.01)
(Pirastu et al. 2009)	3,455 children age 5-12 in villages southwest of Italy	current asthma (=ever asthma + current wheeze), from qx	observable mold, dampness, or fungi on the walls or ceiling of the child's bedroom in 1st year of the child's life (early), from qx	1.95 (1.15 to 3.30)
			observable mold, dampness, or fungi on the walls or ceiling of the child's bedroom recently (current), from qx	1.25 (0.66 to 2.34)
			observable mold, dampness, or fungi on the walls or ceiling of the child's bedroom in the frst year of the child's life and recently (both), from qx	1.67 (0.90 to 3.10)
Adults and children				
Cross-sectional studies				
(Salo et al. 2006)	2,456 individuals (adults and children) living in non-institutional housing units that permit resident children	current doctor diagnosed asthma	*Alternaria alternata* concentration (in floor and furniture dust), adjusted model,	
			1st tertile	1.00
			2nd tertile	1.52 (0.90-2.55
			3rd tertile	1.84 (1.18-2.85)
			Alternaria alternata concentration, adjusted model including other indoor allergens, 1st tertile	1.00
			2nd tertile	1.56 (0.96-2.53)
			3rd tertile	1.89 (1.25-2.85)
			Alternaria alternata concentration,	

Table A2.4 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			adjusted model including other indoor allergens and dust weight,	
			1st tertile	1.00
			2nd tertile	1.55 (0.96-2.52)
			3rd tertile	1.86 (1.22-2.84)
			Alternaria alternata concentration, adjusted model including other indoor allergens, dust weight and endotoxin,	
			1st tertile	1.00
			2nd tertile	1.45 (0.88-2.39)
			3rd tertile	1.73 (1.08-2.77)
(Williamson et al. 1997)	222 participants age 5-44 (90 asthmatics and 132 matched controls)	dr dx asthma and attendance of asthma clinic in 4-month period prior to study	self-reported, any home dampness or condensation	1.93 (1.14-3.28)
			self-reported, serious dampness or condensation	5.45 (2.81-10.6)
			self-reported previous home dampness	2.55 (1.49-4.37)
			inspection-determined any dampness by moisture meter	3.03 (1.65-5.57)
			inspection-determined severe dampness by moisture meter	2.36 (1.34-4.01); significant correlation (r=0.30) between total dampness severity score and asthma severity (p=0.006)
			inspection-determined any visible mold	1.35 (0.79-2.28);
			inspection-determined significant visible mold per mold score	1.70 (0.78-3.71); significant correlation (r=0.23) between total mold severity score and asthma severity (p=0.04)

Table A2.4 (cont.)

** Since this relates to an absence of dampness it implies that home dampness is a risk factor for asthma

Table A2.5 (cont.)

A2.5. Dyspnea

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Cross-sectional studies				
(Thorn and Rylander 1998)	129 adults age 18-83	Chest tightness	Airborne **(1□3)-**ß-D-**glucan (**while disturbing settled dust) --	
			>2-4 ng/m^3	2.97 (1.26-7.02)
			>4 ng/m^3	1.35 (0.52-3.56)
(Nriagu et al. 1999)	693 adults in South Africa	shortness of breath with wheeze	Home dampness	1.04 (0.46-2.34)
(Park et al. 2004)	323 employees in 13 college buildings	shortness of breath	Water stains, continuous variable	1.7 (0.8-3.6)
			Water stains, any stains	6.3 (0.8-51.1)
			Any visible mold	2.6 (1.3-5.1)
			Any mold odor	1.4 (0.7-3.2)
			Any damp material or standing water	3.3 (0.9-11.9)
			Factor combinations, water-stain-weighted	2.7 (1.2-6.1)
			Factor combinations, visible-mold-weighted	2.5 (1.2-5.4)
(Brunekreef 1992b)	3,488 adult female parents of children age 6-12	lower respiratory symptoms	Damp stains and/or mold	1.55 (1.27-1.89)
	3,184 adult male parents of children age 6-12			1.70 (1.38-2.09)
(Gunnbjornsdottir et al. 2006)	15,995 subjects age 20-44 from Iceland, Norway, Denmark, Sweden, and Estonia who had participated in the European Community Respiratory Health Survey (ECRHS I)	nocturnal breathlessness	Water damage	1.81 (1.50-2.19)
			Wet floors	2.58 (1.93-3.45)
			Visible molds	1.72 (1.35-2.20)
			Any dampness	1.80 (1.51-2.15)
			Onset in damp homes	1.33 (1.09-1.63)
			Remission in damp homes	0.68 (0.48-0.96)

Table A2.5 (cont.)

(Skorge et al. 2005)	2,401 adults age 26-82 in Hordaland County, Norway	dyspnea grade 2	Mold, only earlier	1.5 (0.92-2.47)
		attacks of dyspnea		1.7 (1.06-2.72)
		dyspnea grade 2	Mold, earlier and last year	1.4 (0.91-2.10)
		attacks of dyspnea		1.1 (0.74-1.74)
		dyspnea grade 2	Water damage, only earlier	1.4 (0.91-2.10)
		attacks of dyspnea		1.1 (0.74-1.74)
		dyspnea grade 2	Water damage, earlier and last year	1.2 (0.63-2.15)
		attacks of dyspnea		1.2 (0.65-2.07)
		dyspnea grade 2	Molds	AF=4.5 (1.3-7.5)
		attacks of dyspnea		AF=4.1 (0.6-7.5)
(Haverinen et al. 2001)	1,017 adults who lived in selected dwellings for visible signs of moisture damage	dyspnea	2-level classification of dampness -- homes with visible mold growth or mold odor vs. those with neither	1.57 (0.94-2.63)
		nocturnal dyspnea		2.02 (0.86-4.75)
		dyspnea	3-level classification of dampness (1) --	
			Grade I	1.00
		nocturnal dyspnea		1.00
		dyspnea	Grade II	0.95 (0.49-1.85)
		nocturnal dyspnea		2.22 (0.67-7.34)
		dyspnea	Grade III	1.78 (0.90-3.52)
		nocturnal dyspnea		1.49 (0.49-4.57)
(Gunnbjornsdottir et al. 2003)	1,853 young Swedish adults age 20-44	breathless when resting	Only molds	0.90 (0.45-1.81)
		breathless after effort		1.10 (0.64-1.88)
		nocturnal breathlessness		0.94 (0.47-1.87)
		breathless when resting	Only water damage	1.15 (0.34-3.85)
		breathless after effort		1.70 (0.70-4.16)
		nocturnal breathlessness		0.75 (0.18-3.21)
		breathless when	Molds and water damage	3.24 (1.44-7.29)

Table A2.5 (cont.)

		resting breathless after effort		2.76 (1.36-5.60)
		nocturnal breathlessness		1.00 (0.30-3.21)
(Park et al. 2006)	888 occupants of a water-damaged building	chest tightness	Fungi [a]	1.8 (1.12-3.04)
			Fungi (high), Endotoxin (low) [b]	1.1 (0.46-2.69)
			Fungi (low), Endotoxin (high) [b]	1.3 (0.52-3.25)
			Fungi (high), Endotoxin (high) [b]	3.0 (1.42-6.32)
(Bjornsson et al. 1995)	88 individuals age 20-45 in a central Swedish municipality	asthma-related sx in the last 12 mo	total airborne bacteria (by staining on filter)	5.1 (1.3 to 20), OR per 10-fold increase in bacteria concentration
		daytime breathlessness in the last 12 mo		2.7 (0.8 to 9.6)
		nocturnal breathlessness in the last 12 mo		2.7 (0.8 to 9.3)
		asthma-related sx in the last 12 mo	total airborne molds (by staining on filter)	0.8 (0.1 to 5.1)
		daytime breathlessness in the last 12 mo		2.6 (0.5 to 14)
		nocturnal breathlessness in the last 12 mo		2.8 (0.5 to 15)
Children				
Cross-sectional studies				
(Li and Hsu 1996) 1996)	1,340 children age 8-12 in the Taipei area	shortness of breath	Parental dampness	1.55 (1.01-2.38)
			Dampness	1.49 (0.88-2.53)
			Mold	1.55 (1.01-2.38)
			Stuffy odor	1.59 (1.03-2.44)
			Water damage	1.99 (0.82-4.83)
			Flooding	1.16 (0.65-2.05)

Table A2.5 (cont.)

(Cuijpers et al. 1995)	470 Dutch primary school children age 6-12	boys, shortness of breath	Mold growth (always)	2.26 (0.54-9.49)
		boys, attack of shortness of breath + wheeze		1.23 (0.20-7.51)
		boys, shortness of breath"	Mold growth (often)	0.41 (0.04-3.76)
		girls, shortness of breath"		1.93 (0.16-22.74)
		boys, shortness of breath"	Mold growth (sometimes)	0.99 (0.32-3.01)
		girls, shortness of breath"		0.81 (0.16-4.13)
		boys, attack of shortness of breath + wheeze"		0.43 (0.09-2.07)
		girls, attack of shortness of breath + wheeze"		0.44 (0.05-4.36)
(Nafstad et al. 2005)	942 children age 3-5 in Oslo, who attend daycare centres	"heavy breathing or chest tightness"	Dampness problems	1.15 (0.64-2.07)
(Zhao et al. 2008)	1,993 children age 11-15 from 10 randomly selected schools in Taiyuan, China	daytime attacks of breathlessness in the last 12 mo, from qx	muramic acid, per 10 ug/g in vacuumed classroom dust	0.62 (0.46 to 0.84)**
		nocturnal attacks of breathlessness in the last 12 mo, from qx		0.38 (0.12 to 1.15)
		daytime attacks of breathlessness in the last 12 mo, from qx	ergosterol, per ug/g in vacuumed classroom dust	0.82 (0.61 to 1.11)
		nocturnal attacks of breathlessness in the last 12 mo, from qx		1.63 (0.69 to 3.80)
		daytime attacks of breathlessness in the last 12 mo, from qx	LPS, per 10 nmol/g in vacuumed classroom dust	1.27 (1.04 to 1.54)*

Table A2.5 (cont.)

		nocturnal attacks of breathlessness in the last 12 mo, from qx		1.45 (0.76 to 2.76)
		daytime attacks of breathlessness in the last 12 mo, from qx	concentration of C10 3-OH FA per 10 nmol/g in vacuumed classroom dust	0.39 (0.20 to 0.78)**
		nocturnal attacks of breathlessness in the last 12 mo, from qx		0.07 (0.01 to 1.10)
		daytime attacks of breathlessness in the last 12 mo, from qx	concentration of C18 3-OH FA per 10 nmol/g in vacuumed classroom dust	1.03 (0.95 to 1.11)
		nocturnal attacks of breathlessness in the last 12 mo, from qx		1.01 (0.78 to 1.30)
Infants, Children, and Adults				
Intervention studies				
(Burr et al. 2007)	182 current asthmatics age 3-61 with indoor mold in South Wales	perceived breathing since baseline – difference in proportion improving, intervention vs. controls	controlled intervention -- visible mold removal plus fungicide and installation of ventilation fan	difference in net % better -- 0-6 mo: 52% (30 to 74); 0-12 mo: 29% (10 to 47)

AF = Attributable Fraction (%)

[a] No interaction models

[b] Interaction models

(1)Grade I: (No visible moisture damage; minor moisture damage; one patch of deteriorated interior finish or covering, which needed drying, re-gluing or fixing)

Grade II: Single observation of a damaged interior structural component that needed opening, drying and renewal or minor repair; single patch of deteriorated interior finish or covering, as in Grade I, plus other damage of the same or lower level of severity, but not higher)

Grade III: The presence of a damaged interior structural component , as in Grade II, together with other damage of the same level of severity or less; A functional element that needed partial or total renewal, together with or without the presence of other damage)

A2.6. Wheeze

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Cross-sectional studies				
(Strachan and Carey 1995)	961 secondary pupils in Sheffield. 486 cases and 475 controls	"frequent attacks of wheezing"	No bedroom damp and mold	1.00
			Damp only	1.19
			Damp with mold	1.69
		"speech-limiting wheezing"	No bedroom damp and mold	1.00
			Damp only	1.04
			Damp with mold	2.36 P<0.05
		"frequent and speech limiting wheezing"	No bedroom damp and mold	1.00
			Damp only	undefined
			Damp with mold	2.55 P<0.05
(Nriagu et al. 1999)	693 adults in South Africa	"wheeze"	Home dampness	2.13 (0.95-4.75)
(Dharmage et al. 2001)	485 Participants in a follow-up study to the European Community Respiratory Health Survey (ECRHS)	"wheeze only"	Ergosterol levels in the upper three quartiles compared with the first quartile	range 3.6-4.7, all p<0.05
(Park et al. 2004)	323 employees in 13 college buildings	wheeze	Water stains, continuous variable	2.3 (1.1-4.5)
			Water stains, any stains	2.6 (0.7-9.2)
			Any visible mold	2.0 (1.1-3.7)
			Any mold odor	1.1 (0.5-2.3)
			Any damp material or standing water	1.2 (0.3-4.5)
			Factor combinations, water-stain-weighted	1.8 (0.9-3.5)

Table A2.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			Factor combinations, visible-mold-weighted	1.7 (0.9-3.4)
(Brunekreef 1992b)	3,488 adult female parents of children age 6-12 3,184 adult male parents of children age 6-12	wheeze	Damp stains and/or mold	1.43 (1.15-1.77) in women 1.63 (1.30-2.06) in men
(Gunnbjornsdottir et al. 2006)	15,995 subjects age 20-44 from Iceland, Norway, Denmark, Sweden, and Estonia who had participated in the European Community Respiratory Health Survey (ECRHS I)	wheeze	Water damage	1.32 (1.17-1.49)
			Wet floor	1.54 (1.25-1.90)
			Visible molds	1.54 (1.31-1.80)
			Any dampness	1.38 (1.24-1.53)
			Onset in damp homes	1.28 (1.12-1.46)
			Remission in damp homes	0.88 (0.74-1.03)
(Rennie et al. 2005)	1,998 adults age 18-74	for "men, wheeze with shortness of breath"	Damp housing	1.29 (0.62-2.67)
		for "women, wheeze with shortness of breath"		1.85 (1.08-3.17)
(Skorge et al. 2005)	2,401 adults age 26-82 in Hordaland County, Norway	wheezing	Mold, only earlier	1.5 (0.99-2.34)
			Mold, earlier and last year	1.3 (0.92-1.86)
			Water damage, only earlier	1.3 (0.92-1.86)
			Water damage, earlier and last year	1.0 (0.61-1.69)
			Molds	AF=4.7 (2.0-7.2)
(Haverinen et al. 2001)	1,017 adults who lived in selected dwellings for visible signs of moisture damage /	wheezing	2-level classification of dampness -- homes with visible mold growth or mold odor vs. those with neither	0.83 (0.43-1.60)

Table A2.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			3-level classification of dampness(1)	
			Grade I	1.00
			Grade II	0.44 (0.14-1.34)
			Grade III	1.52 (0.67-3.47)
(Ruotsalainen et al. 1995)	268 female day-care workers in Espoo, Finland	for "chronic wheezing"	Water damage, no mold odor	1.66 (0.72-3.82)
			Water damage and mold odor	1.28 (0.44-3.73)
(Zock et al. 2002)	18,873 people from 38 study centers from the ECRHS	wheezing and breathlessness in last year	Water damage in last year	1.16 (1.00-1.34)
		wheezing apart from colds in last year		1.23 (1.06-1.44)
		wheezing and breathlessness in last year	Water on basement floor	1.46 (1.07-2.01)
		wheezing apart from colds in last year		1.26 (0.81-1.98)
		wheezing and breathlessness in last year	Mold or mildew in last year	1.34 (1.18-1.51)
		wheezing apart from colds in last year		1.44 (1.30-1.60)
(Potts et al. 2008)	1,232 adults age 22-28 in Chile, 21% of the sample was replaced	wheeze in the past 12 mo, from qx	mold on any surface other than food, from qx	1.39 (0.99 to 1.95)
			household leaks in the past 12 mo from broken pipes, roof leaks, and inundations from heavy rain, from qx	1.49 (1.06 to 2.10)
(Sun et al. 2009)	3,436 college students age 17-45 in China	wheeze in the last 12 mo, from qx	visible mold spot	1.29 (0.90 to 1.85)
			damp stain	1.08 (0.80 to 1.47)
			suspected moisture problem not visible on walls, ceiilings, and floors	1.20 (0.93 to 1.54)

Table A2.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			water damage	1.05 (0.72 to 1.54)
			water condensation on the inner windowpane in winter > 25cm	0.83 (0.58 to 1.21)
(Bjornsson et al. 1995)	88 individuals age 20-45 in a central Swedish municipality	wheezing in the last 12 mo	total airborne bacteria (by staining on filter)	4.2 (1.2 to 14)
			total airborne molds (by staining on filter)	0.4 (0.1 to 2.4)
Children				
Prospective studies				
(Emenius et al. 2004a)	540 infants age 2. 181 cases with recurrent wheeze and 359 controls	recurrent wheeze (≥3 episodes after 3 months of age) plus either use of inhaled steroids or symptoms suggestive of bronchial hyper-reactivity	Windowpane condensation four questionnaires	2.2 (1.1-4.5)
(Emenius et al. 2004b)	540 infants age 2. 181 cases with recurrent wheeze and 359 controls	recurrent wheeze (≥ 3episodes after 3 months of age) plus either use of inhaled steroids or symptoms suggestive of bronchial hyper-reactivity	Any dampness	1.4 (0.9-2.2)
			Mold odor	2.0 (1.0-3.9
			Mold spots on surface material/tile joints in wet areas (shower/bathroom)	1.0 (0.5-1.7)
			Any other sign of dampness	1.6 (1.0-2.5)

Table A2.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			Any other sign of dampness combined with reported window-pane condensation >2 times, absolute indoor humidity level >5.8 g/m^3	2.0 (1.2-3.4)
			Prospectively reported dampness or noted at inspection	1.5 (1.0-2.3)
			Sign of dampness both prospectively and currently at the time of inspection	1.8 (0.9-3.5)
			Window-pane condensation on all 3 questionnaires + inspection form	2.2 (1.1-4.5)
			1sign of dampness	1.3 (0.8-2.2)
			3 or more signs of dampness	2.7 (1.3-5.4)
	Infants (2 years old, unspecified number remaining in study from birth cohort of 4,089 infants)	Recurrent wheeze (≥ 3 episodes after 3 months of age) plus either use of inhaled steroids or symptoms suggestive of bronchial hyper-reactivity	Damage by damp	1.4 (1.1-1.8)
			Mold odor	1.6 (1.1-2.3)
			Visible mold last year	1.5 (1.0-2.2)
			Any sign of dampness	1.4 (1.1-1.8)
			1 of 3 signs of dampness	1.2 (0.9-1.7)
			2 of 3 signs of dampness	1.5 (1.0-2.4)
			3 of 3 signs of dampness	2.2 (1.3-4.2)
(Douwes et al. 2006)	696 children with atopic mothers	wheeze in the past 12 months	Glucan, medium	1.50 (0.77-2.94)
		wheeze, early transient in past 4 years		0.89 (0.46-1.71)

Table A2.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		wheeze, persistent in past 4 years		1.16 (0.52-2.62)
		wheeze in the past 12 months	Glucan, high	0.76 (0.34-1.72)
		wheeze, early transient in past 4 years		0.57 (0.28-1.16)
		wheeze, persistent in past 4 years		0.43 (0.15-1.21)
		wheeze in the past 12 months	Extracellular polysaccharides-*Aspergillus*/*Penicillium*, Médium	1.28 (0.70-2.32)
		wheeze, early transient in past 4 years		0.99 (0.56-1.76)
		wheeze, persistent in past 4 years		1.07 (0.53-2.16)
		wheeze in the past 12 months	Extracellular polysaccharides-*Aspergillus*/*Penicillium*, high	0.63 (0.30-1.32)
		wheeze, early transient in past 4 years		0.67 (0.36-1.23)
		wheeze, persistent in past 4 years		0.37 (0.15-0.96)
(Cho et al. 2006)	640 infants of at least one atopic parent	recurrent wheezing	Mold (minor damage)	1.2 (0.9-1.7)
			Mold (major damage)	2.1 (1.2-3.6)
		recurrent wheezing combined with any allergen	Mold (minor damage)	4.7 (2.1-10.5
			Mold (major damage)	6.0 (2.2-14.2)
(Diez et al. 2003)	186 children age1-2 in Germany whose apartments were redecorated during this period	wheezing during the 1st year of life	dampness in the apartment	1.9 (0.7-5.0)

Table A2.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		wheezing during the 2nd year of life	dampness in the apartment	1.3 (0.4-4.2)
(Karvonen et al. 2009)	396 children followed from birth to 18 months, half from rural areas of Finland in PASTURE study, half from Kuopio Univ Hospital	parent-reported wheezing apart from cold at 12 and/or 18 mo, from qx	moisture damage with major need for repair, any in whole house (2)	3.00 (1.15-7.84)
			indoor mold odor, any in whole house	2.78 (0.95-8.19)
			visible indoor mold, any in whole house	1.98 (0.90-4.35)
			major moisture damage in the kitchen (2)	6.15 (2.01-18.82)
			mold in the kitchen	1.96 (0.89-4.31)
			major moisture damage in the main living area (2)	1.17 (0.48-2.85)
			mold in the main living area	1.22 (0.43-3.45)
			moisture damage in the child's bedroom	0.68 (0.26-1.80)
			mold in the child's bedroom	1.92 (0.48-7.60)
		dr-dx obstructive or asthmatic bronchitis, from parental qx	major moisture damage in the main living area (2)	1.97 (0.79-4.93)
			mold in the main living area	3.92 (1.54-10.00)
			moisture damage in the child's bedroom	1.29 (0.50-3.32)
			mold in the child's bedroom	5.22 (1.48-18.35)
(Iossifova et al. 2007)	574 infants born to atopic parents	recurrent wheezing at age 11-18 mo, among all	(1-3)-ß-D-glucan (ug/g) in settled dust at age 8 mo – ORs are for the top of each quartile compared to the bottom of that quartile --	
			first quartile	3.04 (1.25-7.38)
			second quartile	1.29 (0.99-1.67)
			third quartile	0.82 (0.65-1.05)
			fourth quartile	0.39 (0.16-0.93)
			Estimated ORs for the top of each quartile relative to the bottom of the first quartile are: 3.04, 3.92, 3,22, 1.25	

Table A2.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		recurrent wheezing at age 11-18 mo, among atopics only	first quartile	160 (4.85-5311)
			second quartile	2.54 (0.97-6.62)
			third quartile	0.17 (0.05-0.57)
			fourth quartile	0.00 (0.00-0.07)
			Estimated ORs for the top of each quartile relative to the bottom of the first quartile are: 4.89, 6.94, 3,51, 0.46	
		recurrent wheezing plus atopy by SPT at age 11-18 mo, vs. no wheeze, no atopy	first quartile	4.89 (1.02-23.57)
			second quartile	1.23 (0.79-1.92)
			third quartile	0.59 (0.38-0./92)
			fourth quartile	0.13 (0.03-0.61)
			Estimated ORs for the top of each quartile relative to the bottom of the first quartile are: 160., 406., 69, 0. When exposure in two categories, 60 vs. 3 ug/g, OR=6.05 (0.84-43.79) 900 vs. 60 ug/g, OR=0.08 (0.01-0.59)	
			endotoxin in dust, interquartile range	0.99(0.71-1.37)
(Iossifova et al. 2009)	483 children age 3, born to atopic parent from Cincinati	Recurrent wheezing in children with atopy at age 3	low mold/water damage = moldy odor or visibile mold or water damage area < 0.2 m^2 (versus no odor, mold, or water damage), from home inspection at age 8 mo	1.86 (0.86 to 4.00)
			high mold/water damage = visibile mold or water damage area ≥ 0.2 m^2, from home inspection at age 8 mo	6.16 (1.38 to 27.44)

Table A2.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			(1-3)-ß-D-glucan (ug/g) in settled dust at age 8 mo – ORs are for the top of each quartile compared to the bottom of that quartile --	
			first quartile	
			second quartile	
			third quartile	
			fourth quartile	
			(estimated ORs for the top of each quartile relative to the bottom of the first quartile are: 1.91, 1.85, 1.48, 0.70)	1.91 (0.18-20.56) 0.97 (0.72-1.31) 0.80 (0.54-1.18) 0.47 (0.13-1.71)
			endotoxin in dust, interquartile range	1.37 (0.86-2.19)
(Bolte et al. 2003)	1942 infants in pospective cohort at 2 years old	repeated wheeze, from parental qx	endotoxin in mother's mattress dust at age 3 mo, 4th quartile vs. 1st	1.52 (1.08-2.14); among infants with parental atopy, OR 1.77 (1.14-2.73), and p for trend 0.0008
(Gillespie et al. 2006)	881 New Zealand infants followed from birth	wheezing by maternal Qx at 15 mo	endotoxin (EU/g) in bedroom floor dust at age 3 mo, 4th quartile vs. 1st	1.54 (1.03-2.30); with parental allergic history 1.67 (1.07-2.60); among atopic infants 1.94 (0.80-4.72)
(Litonjua et al. 2002)	226 children under 5 years old, followed for 4 yrs	wheezing	endotoxin in house dust at baseline, levels higher than median	1.52 (1.07-2,14)
		repeated wheezing		2.57 (1.00-6.62)
(Perzanowski et al. 2006)	301 children of Dominican or African American mothers in New York City	wheeze at age 2 yrs	endotoxin in floor dust samples in bedrooms at age 12 mo (for 47 children, at 36 mo); ORs for EU/mg dust	1.34 (1.01-1.78)
		wheeze at age 3 yrs		1.04 (0.71-1.50)

Table A2.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Iossifova et al. 2007)	574 infants born to atopic parents	recurrent wheezing at age 11-18 mo, among all	(1-3)-ß-D-glucan (ug/g) in settled dust at age 8 mo – ORs are for the top of each quartile compared to the bottom of that quartile --	
			first quartile	3.04 (1.25-7.38)
			second quartile	1.29 (0.99-1.67)
			third quartile	0.82 (0.65-1.05)
			fourth quartile	0.39 (0.16-0.93)
		recurrent wheezing at age 11-18 mo, among atopics only	first quartile	160 (4.85-5311)
			second quartile	2.54 (0.97-6.62)
			third quartile	0.17 (0.05-0.57)
			fourth quartile	0.00 (0.00-0.07);
		recurrent wheezing plus atopy by SPT at age 11-18 mo, vs. no wheeze, no atopy	first quartile	4.89 (1.02-23.57)
			second quartile	1.23 (0.79-1.92)
			third quartile	0.59 (0.38-0./92)
			fourth quartile	0.13 (0.03-0.61)
		recurrent wheeze	endotoxin in dust, interquartile range	0.99(0.71-1.37)
Retrospective studies				
(Alper et al. 2006)	858 primary school children age 7 in Bursa, Turkey.	"no wheezing"	Dampness and mold at home	1.0
		"wheezing in first 3 years"		2.37 (1.52-3.69)
		"early transient wheezing"		2.28 (1.34-3.87)
		"persistent wheezing"		2.53 (1.30-4.87)
		"late-onset wheezing"		2.46 (1.29-4.66)
Cross-sectional studies				
(Bornehag et al. 2005)	10,851 preschool children age 1-6 in Sweden	for "wheezing"	Water leakage	1.15 (1.02-1.31)
			Floor moisture	1.53 (1.25-1.87)

Table A2.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			Visible dampness	1.53 (1.08-2.18)
(Simoni et al. 2005)	20,016 children (mean age 7 years)	Children, current asthma	Mold/dampness – never	
				1.00
			current only	1.62 (1.22-2.15)
			early only (1st yr of life)	1.65 (1.31-2.07)
			both current and early	1.98 (1.47-2.66)
	13,266 adolescents (mean age 13 years)	Adolescents, current asthma	Mold/dampness – never	
				1.00
			current only	1.33 (0.98-1.82)
			early only (1st yr of life)	1.56 (1.15-2.11)
			both current and early	1.33 (0.84-2.10)
(Li and Hsu 1996) 1996)	1,340 children age 8-12 in the Taipei area	wheeze	Parental-reported dampness	1.36 (0.83-2.21)
			Dampness	1.11 (0.63-1.93)
			Mold	1.20 (0.73-1.99)
			Stuffy odor	1.68 (1.03-2.74)
			Water damage	1.43 (0.48-4.30)
			Flooding	1.30 (0.69-2.45)
(Peters et al. 1999)	3,676 Southern Californian children	wheeze	Water damage	1.15
			Mildew	1.94 P<0.05
(Spengler et al. 2004)	5,951 children age 8-12 in 8 Russian cities	for "current wheeze"	Water damage	1.53 (1.19-1.95)
			Presence of molds	1.52 (1.19-1.94)
(Strachan and Elton 1986)	165 children age 7-8	wheezing illness (age 0-5)	Damp	2.1[b] (p≥0.05)
		wheezing illness (age 5-7)		1.7[b] (p≥0.05)
		wheezing illness (age 0-5)	Mold	2.2[b] (p≥0.05)
		wheezing illness (age 5-7)		1.5[b] (p≥0.05)

Table A2.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Venn et al. 2003)	416 children age 9-11. 193 cases with persistent wheezing illness and 223 controls	wheeze		
			Living room damp	
			very low	1.00
			low	1.37 (0.84-2.25)
			moderate	1.60 (0.73-3.49)
			high	2.48 (0.90-6.82)
			Kitchen damp	
			very low	1.00
			low	1.14 (0.64-2.02)
			moderate	1.65 (0.77-3.55)
			high	1.03 (0.33-3.16)
			Bedroom damp	
			very low	1.00
			low	1.49 (0.94-2.36)
			mod/high	1.26 (0.60-2.64)
			Visible mold	5.10 (1.07-24.17)
		frequent night-time symptoms	Living room damp	
			very low	1.00
			low	2.02 (0.81-5.04)
			moderate/high	3.86 (1.20-12.45)
			Kitchen damp	
			very low	1.00
			low	2.49 (0.90-6.89)
			moderate/high	3.56 (1.05-12.08)
			Bedroom damp	
			very low	1.00
			low	2.32 (1.04-5.16)
			mod/high	7.03 (1.66-29.79)
		frequent day-time symptoms	Living room damp	
			very low	1.00
			low	2.33 (0.93-5.83)
			moderate/high	3.23 (0.97-10.78)
			Kitchen damp	
			very low	1.00

Table A2.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			low	1.71 (0.59-4.96)
			moderate/high	1.37 (0.38-5.00)
			Bedroom damp	
			very low	1.00
			low	0.95 (0.42-4.96)
			mod/high	1.72 (0.41-7.32)
(Yang et al. 1997a)	4,164 primary school children age 6-12 in Kaohsiung rural areas in Taiwan	wheeze	Home dampness	1.88 (1.36-2.59)
(Yang et al. 1997b; Yang et al. 1997b)	4,164 primary school children age 6-12 in Kaohsiung rural areas in Taiwan	wheeze	Home dampness	1.81 (1.32-2.47)
(Yangzong et al. 2006)	2,026 children age 12-14living at altitudes above 3,900m in Tibet	"wheeze at rest"	Dampness problems	2.0 (1.1-3.6)
		"wheeze after exercise"		1.3 (0.8-2.2)
		"night waking with wheeze"		2.1 (1.1-4.1)
		"severe wheeze"		2.3 (1.0-5.2)
(Cuijpers et al. 1995)	470 Dutch primary school children age 6-12	boys, wheeze	Mold growth (always)	0.95 (0.16-5.46)
		Girls, wheeze		2.69 (0.48-15.21)
		boys, wheeze	Mold growth (often)	0.46 (0.05-4.47)
		Girls, wheeze		0.79 (0.06-10.66)
		boys, wheeze	Mold growth (sometimes)	0.50 (0.13-1.89)
		Girls, wheeze		0.54 (0.14-2.11)
(Dong et al. 2008a)	10,784 children age 6-13 from urban areas in northeast China	current wheeze	mold in the past 12 mo (signs of flooding, water damage or mold growth in the home)	1.65 (1.25 to 2.17)
(Schram-Bijkerk et al. 2005)	899 children age 5-13 from Austria, Germany, the Netherlands, Sweden, and Switzerland, including 168 current atopic wheezers and 441 controls	atopic wheeze in farm and farm-reference children, from qx	endotoxin, interquartile range increase, from vacuumed mattresses and living room floors	1.03 (0.69 to 1.55)
		current atopic wheeze in farm and farm-reference children in the last 12 mo, from qx		1.09 (0.66 to 1.78)

Table A2.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		atopic wheeze in farm and farm-reference children, from qx	EPS, interquartile range increase, from vaccummed mattresses and living room floors	0.95 (0.70 to 1.30)
		current atopic wheeze in farm and farm-reference children in the last 12 mo, from qx		0.77 (0.54 to 1.10)
		atopic wheeze in farm and farm-reference children, from qx	glucans, interquartile range increase, from vaccummed mattresses and living room floors	0.83 (0.56 to 1.22)
(Dong et al. 2008b)	3,945 children age 1-6 from kindergartens in northeast China	current wheeze	mold in past 12 mo (signs of flooding, water damage, or mold growth in home; from parental qx)	2.07 (1.56-2.75)
(Jeedrychowski et al. 2007)	275 children age 3 born to non-smYing mothers in Poland	total no. wheezing days over the last 6 mo, from maternal interview	visible patches of mold growth on the internal walls of the household	IRR 4.24 (3.08 to 5.84)
		no. wheezing episodes in the last 6 mo, from maternal interview		IRR 3.22 (1.37 to 7.54)
		total no. wheezing days over the last 6 mo, from maternal interview	house dampness	IRR 1.38 (0.94 to 2.01)
		no. wheezing episodes in the last 6 mo, from maternal interview		IRR 1.49 (0.60 to 3.66)
(Mommers et al. 2005)	1,191 children age 7-8 living in the Dutch-German borderland	wheeze	mold or dampness – short period vs. never	1.97 (1.21–3.22)
			long period vs. never	2.98 (1.10–8.28)
			always vs. never	0.76 (0.21–2.57)

Table A2.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Pirastu et al. 2009)	3,455 children age 5-12 in villages southwest of Italy	current wheeze, from qx	observable mold, dampness, or fungi on the walls or ceiling of the child's bedroom in 1st year of the child's life (early), from qx	1.96 (1.34 to 2.88)
			observable mold, dampness, or fungi on the walls or ceiling of the child's bedroom recently (current), from qx	1.31 (0.84 to 2.05)
			observable mold, dampness, or fungi on the walls or ceiling of the child's bedroom in the frst year of the child's life and recently (both), from qx	2.41 (1.59 to 3.65)
(Ronmark et al. 2002)	3,431children age 7-8 in northern Sweden	wheeze, incident in prior 12 mo	parent-reported dampness at home	1.25 (0.79-1.96)
(Tham et al. 2007)	4,759 children age 1.5-6 in 120 day-care centers in Singapore	wheezing in the last 12 mo, from qx	visible damp stains on the floor, walls, or ceilings in the room the child sleeps, from qx	1.14 (0.82 to 1.58)
		wheezed after exercise in the past 12 mo, from qx		1.10 (0.53 to 2.28)
		wheezing in the last 12 mo, from qx	visible mold on the floor, walls, or ceilings in the room the child sleeps, from qx	1.34 (0.91 to 1.96)
		wheezed after exercise in the past 12 mo, from qx		1.86 (0.89 to 3.89)
(Zhao et al. 2008)	1,993 children age 11-15 from 10 randomly selected schools in Taiyuan, China	wheezing or whistling in the chest in the last 12 mo, from qx	muramic acid, per 10 ug/g in vacuumed classroom dust	0.49 (0.29 to 0.85)*
			ergosterol, per ug/g in vacuumed classroom dust	1.06 (0.66 to 1.71)
			LPS, per 10 nmol/g in vacuumed classroom dust	1.27 (0.91 to 1.76)
			C10 3-OH FA per 10 nmol/g in vacuumed classroom dust	0.14 (0.04 to 0.51)**
			C18 3-OH FA per 10 nmol/g in vacuumed classroom dust	1.10 (0.96 to 1.25)

Table A2.6 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(El-Sharif et al. 2003)	273 children age 6-12 in Palestine, note that fungi samples were only collected from 120 households	wheezing in the last 12 mo	presence of damp spots or fungus on walls or ceiling	1.87 (1.06 to 3.32) 1.80 (1.01 to 3.22) model 2 with limited data from SPT and specific IgE
(Chong Neto et al. 2008)	3,003 infants age 12-15 months in Brazil	recurrent wheezing in 1st year of life (from parental qx)	visible mold or humidity stains in house, from parental qx	1.14 (1.04-1.24)
(Campo et al. 2006)	532 Cincinnati infants mean age 12.5 mo, with parental atopy	recurrent wheezing wheezing w/event any wheezing	endotoxin in house dust	1.3 (0.8-1.9) 1.1 (0.7-1.8) 1.1 (0.8-1.6)
(Gehring et al. 2008)	840 children, ages 9-12 yr old, from five European countries	current wheeze	endotoxin concentration in living room floor dust, per interquartile range	0.80 (0.61-1.05)
Infants, Children, and Adults				
Intervention studies				
(Burr et al. 2007)	182 current asthmatics age 3-61 with indoor mold in South Wales	perceived wheeze in last 4 wks -- -- estimated difference in proportion improving, intervention vs. controls perceived wheeze disturbing sleep perceived wheeze limiting speech perceived wheeze affecting activities	controlled intervention -- visible mold removal plus fungicide and installation of ventilation fan	0-6 mo: 9% (-9 to 26); 0-12 mo: -3% (-19 to 12) 0-6 mo: 15% (-7 to 38); 0-12 mo: -16% (-34 to 2) 0-6 mo: 12% (-2 to 26); 0-12 mo: 8% (-2 to 18) 0-6 mo: 25% (3 to 47); 0-12 mo: 5% (-15 to 26)

[a] Incidence (mean ± SD)

Table A2.6 (cont.)

[b] Relative odds of morbidity
AF = Attributable Fraction (%)
RR = Relative Risk
(1) Grade I: No visible moisture damage; minor moisture damage; one patch of deteriorated interior finish or covering, which needed drying, re-gluing or fixing)
Grade II: Single observation of a damaged interior structural component that needed opening, drying and renewal or minor repair; single patch of deteriorated interior finish or covering, as in Grade I, plus other damage of the same or lower level of severity, but not higher)
Grade III: The presence of a damaged interior structural component, as in Grade II, together with other damage of the same level of severity or less; A functional element that needed partial or total renewal, together with or without the presence of other damage
(2) Home inspection by trained building engineers includes 2 categories: no mold and visible mold. Moisture damage in 3 classes: Class 0 & 1 is damage with no need to repair or only cosmetic repair; Class 2 is a repair of surface materials; Class 3 is a repair of structural components; Class 4 & 5 are extensive repair. Major damage means: 1) need repair class 2 with area of damage >= $1m^2$; 2) need repair class 3 with area of damage >= $0.11m^2$; or 3) need repair class 4 or 5.

A2.7. Bronchitis

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Cross-sectional studies				
(Thorn and Rylander 1998)	129 adults age 18-83	chronic bronchitis	Airborne **(1□3)-**ß-D-**glucan (**while disturbing settled dust) --	
			>2-4 ng/m^3	7.99 (0.65-98.05)
			>4 ng/m^3	2.51 (0.23-27.83)
(Ekici et al. 2008)	9,971 adults in Turkey	bronchitis	damp housing during childhood, with 3-level classification of dampness: Grade I, II, and III	1.5 (1.3-1.8)
(Haverinen et al. 2001)	1,017 adults who lived in selected dwellings for visible signs of moisture damage	bronchitis	2-level classification of dampness -- homes with visible mold growth or mold odor vs. those with neither	1.56 (0.96-2.52)
(Pirhonen et al. 1996)	1,460 adults age 25-64	chronic bronchitis	dampness or mold (any of 4 indicators)	1.51 (0.96-2.35)
Children				
Prospective studies				
(Karvonen et al. 2009)	396 children followed from birth to 18 months, half from rural areas of Finland in PASTURE study, half from Kuopio Univ Hospital	dr-dx obstructive or asthmatic bronchitis, from parental qx	moisture damage with major need for repair, any in whole house (1)	2.51 (0.98-6.44)
			indoor mold odor, any in whole house	0.66 (0.14-3.17)
			visible indoor mold, any in whole house	1.39 (0.57-3.39)
			major moisture damage in the kitchen (1)	3.85 (1.16-12.76)
			mold in the kitchen	1.06 (0.41-2.71)
(Diez et al. 2003)	186 children age1-2 in Germany whose apartments were redecorated during this period	obstructive bronchitis during 1st year of life	dampness in the apartment	2.0 (0.8 to 5.0)
		obstructive bronchitis during 2nd year of life	dampness in the apartment	1.0 (0.3 to 3.7)
Cross-sectional studies				
(Yang et al. 1997a)*	4,164 primary school children age 6-12 in Kaohsiung rural areas in Taiwan	bronchitis	Home dampness	1.65 (1.28-2.14)*
(Yang et al. 1997b)*	4,164 primary school children age 6-12 in Kaohsiung rural areas in Taiwan	bronchitis	Home dampness	1.58 (1.23-2.03)*

Table A2.7 (cont.)

(Peters et al. 1999)	3,676 Southern Californian children	bronchitis	Water damage	1.26
			Mildew	1.34 P<0.05
(Spengler et al. 2004)	5,951 children age 8-12 in 8 Russian cities	"current bronchitis"	Water damage	1.52 (1.14-2.03)
			Presence of molds	1.70 (1.28-2.27)
(du Prel et al. 2006)	22,666 children age 6 in East Germany	bronchitis, ever diagnosed	Damp housing conditions	1.25 (1.13-1.37)
	6,222 children age 6 in West Germany	bronchitis, ever diagnosed	Damp housing conditions	1.30 (1.03-1.65)
(Li and Hsu 1996)	1,340 children age 8-12 in the Taipei area	bronchitis	Parental-reported dampness	1.29 (0.96-1.73)
			Dampness	1.89 (1.31-2.73)
			Mold	1.89 (1.31-2.73)
			Stuffy odor	1.40 (1.04-1.89)
			Water damage	2.45 (1.24-4.82)
			Flooding	1.17 (0.79-1.73)
(Brunekreef et al. 1989)	4,625 children age 7-11	bronchitis	Parental-reported molds (ever)	1.48 (1.17-1.87)
			Parental-reported dampness (ever)	1.32 (1.05-1.67)

* These publications focused on the same populations and the risk estimates reported are based on identical analyses (with slightly different ORs)

(1) Home inspection by trained building engineers includes 2 categories: no mold and visible mold. Moisture damage in 3 classes: Class 0 & 1 is damage with no need to repair or only cosmetic repair; Class 2 is a repair of surface materials; Class 3 is a repair of structural components; Class 4 & 5 are extensive repair. Major damage means: 1) need repair class 2 with area of damage >= $1m^2$; 2) need repair class 3 with area of damage >= $0.11m^2$; or 3) need repair class 4 or 5.

A2.8. Altered lung function

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Prospective studies				
(Dharmage et al. 2002)	35 young adults with current asthma and sensitization to fungi from ECRHS	Peak flow variability	Visible mold	1.4-fold increase, P=0.02
Cross-sectional studies				
(Gunnbjornsdottir et al. 2003)	1,853 young Swedish adults age 20-44	FEV_1 (ml), exposed vs. not, linear regression estimates (95% CIs)	Only molds in house in last 12 mo	-36 (-103-32)
		FVC (ml)		-16 (-98-65)
		FEV_1 (ml)	Only water damage in house in last 12 mo	-77 (-207-54)
		FVC (ml)		29 (-129-186
		FEV_1 (ml)	Molds and water damage in house in last 12 mo	-20 (-141-102)
		FVC (ml)		-85 (-231-61)
(Norbäck et al. 1999)	455 adults, 98 prevalent cases of asthma and 357 controls	% pred. FEV_1	No signs of dampness vs. Dampness in the floor	108% (SD 16%) 102% (SD 13%) P<0.05
		Average PEF variability	No signs of dampness vs. Dampness in the floor	3.8% (SD 3.1%) 5.4% (SD 5.0%) P<0.01
(Ebbehoj et al. 2005)	522 teachers from 15 public schools (eight water damaged and seven non-damaged)		Estimated level of viable molds in floor dust: lowest fifth, intermediate three fifths, and highest fifth	% expected, mean (sd)
		FEV_1 for male teachers	Low level	101.0 (10.6)
			Medium level	95.4 (16.1) NS
			High level	99.9 (19.2) NS

Table A2.8 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		FVC for male teachers:	Low level	105.8 (14.2)
			Medium level	101.0 (19.5) NS
			High level	103.0 (19.1) NS
		KCO for male teachers:	Low level	116.0 (16.6)
			Medium level	119.6 (19.4) NS
			High level	117.7 (14.7) NS
		DLCO for male teachers:	Low level	107.1 (15.5)
			Medium level	103.3 (18.4) NS
			High level	105.6 (10.8) NS
		FEV_1 for female teachers:	Low level	105.6 (12.3)
			Medium level	103.5 (13.9) NS
			High level	105.8 (12.7) NS
		FVC for female teachers:	Low level	111.7 (20.0)
			Medium level	106.5 (15.3) NS
			High level	108.5 (12.7) NS
		KCO for female teachers:	Low level	105.6 (14.0)
			Medium level	106.9 (15.3) NS
			High level	107.5 (17.3) NS
		DLCO for female teachers:	Low level	97.0 (13.3)
			Medium level	94.7 (13.9) NS
			High level	97.6 (14.7) NS
Children				
Intervention studies				
(Bernstein et al. 2006)	19 mold-sensitized asthmatic children age 5-17 with home ventilation systems	Pulmonary function – difference in PEFR variability between intervention and control (negative = improvement)	Ultraviolet radiation intervention to reduce microbial exposures over a two week period	-0.068 P=0.03
		Pulmonary function –		-0.87. P=0.32

Table A2.8 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		difference in FEV1		
Prospective studies				
(Brunekreef et al. 1989)	4,625 children age 8-12 living in six U.S. cities	FVC	Molds	0.44* (-0.27-1.15)
		FEV_1		0.03* (-0.75-0.82)
		FEV_{25-75}		-1.62* (-3.19 - -0.02)
		FVC	Water damage	0.25* (-0.61-1.12)
		FEV_1		0.35* (-0.59-1.30)
		FEV_{25-75}		0.46* (-1.49-2.45)
		FVC	Basement water	0.16* (-0.54-0.87)
		FEV_1		-0.14* (-0.92-0.65)
		FEV_{25-75}		-1.14* (-2.74-0.44)
		FVC	Dampness	-0.09* (-0.75-0.58)
		FEV_1		-0.21* (-0.93-0.52)
		FEV_{25-75}		-1.06* (-2.55-0.44)
Cross-sectional studies				
(Hagmolen of Ten Have et al. 2007)	526 asthmatic children, median age 11	PEF variability, exposed vs. not	damp stains or mold growth, in living room or bedroom, in last 2 years, from parental qx	Linear regression coefficient (95% CI), 2.7 (0.92-4.47)
Retrospective studies				
(Andriessen et al. 1998)	1,614 children who were positive to symptoms of asthma and chronic cough	Variability ratios of: mean daily variation of PEF, exposed vs. not	Moisture stains	0.98 (0.92-1.03)†
		ratios of CV, morning PEF		0.98 (0.92-1.04)†
		Ratios of CV, evening PEF		1.01 (0.95-1.07)†
		Ratios of minimum morning PEF variation		0.99 (0.97-1.02)†
		Variability ratios of mean daily variation of PEF	Molds	1.05 (0.98-1.12)†
		Ratios of CV,		1.04 (0.97-1.11)†

Table A2.8 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		morning PEF Ratios of CV, evening PEF Ratios of minimum morning PEF variation		1.04 (0.97-1.11)† 1.00 (0.97-1.03)†
Infants, children, and adults ***Intervention studies***				
(Burr et al. 2007)	182 current asthmatics age 3-61 with indoor mold in South Wales	mean reduction in CV of PEFR -- -- estimated difference in proportion improving, intervention vs. controls	controlled intervention -- visible mold removal plus fungicide and installation of ventilation fan	Morning -- 0-6 mo: 1.59% (-0.40 to 3.58); 0-12 mo: 0.46% (-1.58 to 2.50); Evening -- 0-6 mo: 0.21% (-1.90 to 2.31); 0-12 mo: 1.42% (-0.58 to 3.43)

CFU = Colony Forming Units
CV = Coefficient of Variation
DLCO = Total lung diffusion capacity for carbon monoxide
FVC = Forced Vital Capacity
FEV_1 = Forced Expiratory Volume in 1st second
KCO = alveolar diffusion constant for carbon monoxide
NS = Not (statistically) Significant
PEF = Peak Expiratory Flow
* Difference in mean pulmonary function, expressed as percentage of the grand mean, between children living in damp homes and children living in dry homes.
† Adjusted mean daily variation of PEF over the study period
daily variation: (morning-evening PEF)/(morning+evening PEF)/2) (in %)

A2.9. Cough

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Cross-sectional studies				
(Haverinen-Shaughnessy et al. 2007)	81 randomly selected elementary school teachers	cough today, from diary	Airborne, personal samples	
			Total fungi	1.11 (0.72-1.70)
			Viable fungi, MEA	0.77 (0.55-1.09)
			Viable fungi, DG18	0.65 (0.48-0.89)
			Total bacteria	2.04 (1.10-3.77)
			Viable bacteria	1.33 (0.76-2.33)
			Airborne, home	
			Total fungi	0.96 (0.69-1.34)
			Viable fungi, MEA	0.57 (0.37-0.89)
			Viable fungi, DG18	0.74 (0.54-1.03)
			Total bacteria	1.02 (0.70-1.50)
			Viable bacteria	0.84 (0.60-1.18)
			Airborne, work	
			Total fungi	1.09 (0.62-1.91)
			Viable fungi, MEA	0.91 (0.53-1.55)
			Viable fungi, DG18	0.71 (0.38-1.32)
			Total bacteria	1.25 (0.82-1.91)
			Viable bacteria	1.26 (0.82-1.93)
(Brunekreef 1992b)	3,488 adult female parents of children age 6-12	cough	Damp stains and/or mold	1.75 (1.30-2.36) in women
	3,184 adult male parents of children age 6-12			2.56 (1.94-3.38) in men
(Gunnbjornsdottir et al. 2006)	15,995 subjects age 20-44 from Iceland, Norway, Denmark, Sweden, and Estonia who had participated in the European Community Respiratory Health Survey (ECRHS I)	nocturnal cough	Water damage	1.34 (1.21-1.49)
		productive cough		1.34 (1.18-1.51)

Table A2.9 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		nocturnal cough	Wet floors	1.66 (1.38-2.00)
		productive cough		1.52 (1.23-1.87)
		nocturnal cough	Visible molds	1.41 (1.22-1.63)
		productive cough		1.36 (1.15-1.61)
		nocturnal cough	Any dampness	1.40 (1.28-1.54)
		productive cough		1.34 (1.20-1.50)
		nocturnal cough	Onset in damp homes	1.26 (1.13-1.41)
		productive cough	Remission in damp homes	0.84 (0.73-0.97)
(Skorge et al. 2005)	2,401 adults age 26-82 in Hordaland County, Norway	cough, with phlegm	Mold, only earlier	1.6 (1.01-2.38)
		chronic cough		1.2 (0.71-2.19)
		cough, with phlegm	Mold, earlier and last year	1.7 (0.84-1.72)
		chronic cough		1.2 (0.74-1.86”
		cough, with phlegm	Water damage, only earlier	1.2 (0.84-1.72)
		chronic cough		1.2 (0.74-1.86)
		cough, with phlegm	Water damage, earlier and last year	1.2 (0.74-2.01)
		chronic cough		1.2 (0.61-2.19)
		cough, with phlegm	Molds	AF=3.4 (1.0-5.9)
		chronic cough		AF=3.9 (0.0-7.6)
(Haverinen et al. 2001)	1,017 adults who lived in selected dwellings for visible signs of moisture damage	cough without phlegm	homes with visible mold growth or mold odor (2-level classification of dampness	1.52 (1.04-2.22)
		cough with phlegm		1.02 (0.72-1.43)
		cough		1.12 (0.64-1.97)
		cough without phlegm	Grade I of 3-level classification of dampness (No visible moisture damage; minor moisture damage; one patch of deteriorated interior finish or covering, which needed	1.00

Table A2.9 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			drying, re-gluing or fixing)	
		cough with phlegm		1.00
		cough		1.00
		cough without phlegm	Grade II (Single observation of a damaged interior structural component that needed opening, drying and renewal or minor repair; single patch of deteriorated interior finish or covering, as in Grade I, plus other damage of the same or lower level of severity, but not higher)	1.23 (0.76-1.98)
		cough with phlegm		0.79 (0.50-1.24)
		cough		0.81 (0.38-1.73)
		cough without phlegm	Grade III (The presence of a damaged interior structural component , as in Grade II, together with other damage of the same level of severity or less; A functional element that needed partial or total renewal, together with or without the presence of other damage)	1.52 (0.94-2.47)
		cough with phlegm		1.10 (0.70-1.73)
		cough		1.04 (0.48-2.21)
(Park et al. 2004)	323 employees in 13 college buildings	cough	Water stains, continuous variable	1.3 (0.6-2.6)
			Water stains, any stains	3.2 (0.7-14.4)
			Any visible mold	1.5 (0.8-2.8)
			Any mold odor	1.7 (0.8-3.6)
			Any damp material or standing water	1.0 (0.2-4.5)
			Factor combinations, water-stain-weighted	1.5 (0.7-3.2)
			Factor combinations, visible-mold-weighted	1.7 (0.8-3.6)
(Gunnbjornsdottir et al. 2003)	1,853 young Swedish adults age 20-44	nocturnal cough	Only molds	1.21 (0.90-1.64)

Table A2.9 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		long-term cough		1.10 (0.74-1.61)
		nocturnal cough	Only water damage	1.67 (0.93-2.98)
		long-term cough		1.46 (0.72-2.94)
		nocturnal cough	Molds and water damage	1.18 (0.68-2.04)
		long-term cough		2.23 (1.24-4.00)
(Ruotsalainen et al. 1995)	268 female day-care workers in Espoo, Finland	cough	Water damage, no mold odor	1.10 (0.17-6.96)
			Water damage and mold odor	2.23 (0.31-15.8)
(Potts et al. 2008)	1,232 adults age 22-28 in Chile, 21% of the sample was replaced	productive cough in the past 12 mo, from qx	mold on any surface other than food, from qx	0.99 (0.64 to 1.53)
		dry cough in the past 12 mo, from qx		1.13 (0.74 to 1.73)
		nocturnal cough in the past 12 mo, from qx		1.15 (0.83 to 1.59)
		productive cough in the past 12 mo, from qx	household leaks in the past 12 mo from broken pipes, roof leaks, and inundations from heavy rain, from qx	1.26 (0.82 to 1.93)
		dry cough in the past 12 mo, from qx		0.90 (0.57 to 1.41)
		nocturnal cough in the past 12 mo, from qx		1.38 (0.98 to 1.92)
(Sun et al. 2009)	3,436 college students age 17-45 in China	dry cough at night in the last 12 mo, from qx	visible mold spot	1.00 (0.62 to 1.61)
			damp stain	1.09 (0.74 to 1.63)
			suspected moisture problem not visible on walls, ceiilings, and floors	1.04 (0.77 to 1.43)
			water damage	1.55 (0.98 to 2.46)
			water condensation on the inner windowpane in winter > 25cm	1.01 (0.63 to 1.62)

Children

Prospective studies

Table A2.9 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Karvonen et al. 2009)	396 children followed from birth to 18 months, half from rural areas of Finland in PASTURE study, half from Kuopio Univ Hospital	nocturnal cough apart from cold at 12 and/or 18 mo, parental qx and interview at 2, 12, and 18 mo of age	moisture damage with major need for repair, any in whole house (4)	1.17 (0.52 to 2.64)
			indoor mold odor, any in whole house	1.33 (0.43 to 4.10)
			visible indoor mold, any in whole house	1.13 (0.51 to 2.53)
			major moisture damage in the kitchen (4)	2.36 (0.72 to 7.79)
			mold in the kitchen	0.94 (0.40 to 2.21)
			major moisture damage in the main living area (4)	2.14 (0.94 to 4.86)
			mold in the main living area	1.73 (0.69 to 4.30)
			moisture damage in the child's bedroom	0.54 (0.20 to 1.43)
			mold in the child's bedroom	1.17 (0.30 to 4.65)
Cross-sectional studies				
(Bornehag et al. 2005)	10,851 preschool children age 1-6 in Sweden	cough at night in the last 12 months	Water leakage	1.22 (1.01-1.47)
			Floor moisture	1.45 (1.09-1.93)
			Visible dampness	2.50 (1.63-3.82)
			Condensation on window	1.61 (1.28-2.02)
(Simoni et al. 2005)	20,016 children (mean age 7 years)	Children, persistent cough w/phlegm	Mold/dampness – never	
				1.00
			current only	1.86 (1.19-2.91)
			early only (1st yr of life)	1.89 (1.31-2.71)
			both current and early	1.64 (0.96-2.79)
	13,266 adolescents (mean age 13 years)	Adolescents, persistent cough w/phlegm	Mold/dampness – never	
				1.00
			current only	1.19 (0.74-1.91)
			early only (1st yr of life)	0.80 (0.46-1.40)
			both current and early	1.48 (0.78-2.81)

Table A2.9 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Forsberg et al. 1997)	15,962 children age 6-12 in Sweden, Finland, and Norway	dry cough	Moisture stains or molds, current exposure	1.6 (1.3-1.9)
			Moisture stains or molds, during the child's first 2 years	1.6 (1.3-2.0)
(Li and Hsu 1996)	1,340 children age 8-12 in the Taipei area	cough	Parental-reported dampness	2.52 (1.34-4.75)
			Dampness	1.43 (0.067-3.05)
			Mold	1.87 (1.00-3.25)
			Stuffy odor	1.66 (0.89-3.11)
			Water damage	5.74 (2.20-14.95)
			Flooding	1.41 (0.64-3.14)
(Mommers et al. 2005)	1,191 children age 7-8 living in the Dutch-German borderland	cough	Mold or damp spots, short period	2.03 (1.32-3.14)
			Mold or damp spots, long period	3.25 (1.35-8.28)
			Mold or damp spots, always	1.24 (0.40-3.88)
(Peters et al. 1999)	3,676 Southern Californian children	cough	Water damage	1.38 P<0.15
			Mildew	1.45 P<0.05
(Spengler et al. 2004)	5,951 children age 8-12 in 8 Russian cities	persistent cough	Water damage	1.51 (1.06-2.16)
		current dry cough		1.35 (1.08-1.69)
		persistent dry cough		1.33 (0.85-2.09)
		persistent cough	Presence of molds	1.88 (1.35-2.63)
		current dry cough		1.40 (1.12-1.76)
		persistent dry cough		1.53 (0.99-2.35)
(Strachan and Elton 1986)	165 children age 7-8	nocturnal coughcu	Damp	4.0[a], P<0.001
			Mold	4.8[a], P<0.001

Table A2.9 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Yang et al. 1997a)	4,164 primary school children, aged 6 to 12 years, in Kaohsiung rural areas in Taiwan	cough	Home dampness	1.65 (1.36-2.00)
(Yang et al. 1997b)	4,164 primary school children, aged 6 to 12 years, in Kaohsiung rural areas in Taiwan	cough	Home dampness	1.71 (1.42-2.06)
(Yangzong et al. 2006)	2,026 children age 12-14 living at altitudes above 3,900m in Tibet	night waking with cough	Dampness problems	2.1 (1.3-3.5)
(du Prel et al. 2006)	22,666 children age 6 in East Germany	frequent cough	Damp housing conditions	1.66 (1.42-1.95)
	6,222 children age 6 in West Germany	frequent cough	Damp housing conditions	2.60 (1.90-3.55)
(Cuijpers et al. 1995)	470 Dutch primary school children age 6-12	chronic cough, boys	Mold growth	
			sometimes	2.26 (0.83-6.15)
			often	1.59 (0.28-9.11)
			always	3.36 (0.80-14.10)
		chronic cough, girls	Mold growth	
			sometimes	0.21 (0.03-1.79)
			often	(not estimated)
			always	0.79 (0.07-8.34)
(Nafstad et al. 2005)	942 children age 3-5 in Oslo, who attend daycare centres	"cough during the night"	Dampness problems	1.23 (0.84-1.81)
(Dong et al. 2008a)	10,784 children age 6-13 from urban areas in northeast China	persistent cough for 4 or more days per week in the last 12 mo, from parental qx	mold in the past 12 mo (signs of flooding, water damage or mold growth in the home)	1.51(1.23 to 1.85)
(Brunekreef 1992a)	1,051 Dutch children age 6-12, studied in 1987	cough on most days	dampness stains	1.97 (0.88-4.41)
			mold	3.06 (1.29-7.26)
	3,344 Dutch children age 6-12, studied in 1989	cough on most days	dampness stains	1.57 (1.06-2.32)
			mold	2.05 (1.35-3.19)
(Dong et al. 2008b)	3,945 children age 1-6 from kindergartens in northeast China	persistent cough, last 12 mo (from parental qx)	mold in past 12 mo (signs of flooding, water damage, or mold growth in home; from parental qx)	1.33 (1.01-1.76)
(Pirastu et al. 2009)	3,455 children age 5-12 in villages southwest of Italy	persistent cough or phlegm for 3+ mo in the past 12 mo, from qx	observable mold, dampness, or fungi on the walls or ceiling of the child's bedroom in 1st year of the child's life (early), from qx	2.42 (1.33 to 4.39)
			observable mold, dampness, or fungi on the walls or ceiling of the child's bedroom recently (current), from qx	2.10 (1.09 to 4.06)

Table A2.9 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			observable mold, dampness, or fungi on the walls or ceiling of the child's bedroom in the frst year of the child's life and recently (both), from qx	2.40 (1.24 to 4.66)
(Tham et al. 2007)	4,759 children age 1.5-6 in 120 day-care centers in Singapore	nocturnal cough in the last 12 mo, from qx	visible damp stains on the floor, walls, or ceilings in the room the child sleeps, from qx	1.11 (0.85 to 1.46)
			visible mold on the floor, walls, or ceilings in the room the child sleeps, from qx	1.20 (0.87 to 1.64)

(1) adjusted for the association between personal exposures with particles and microbial aerosol and symptom diary responses among teachers
(2 adjusted for the association between microenvironmental concentrations of particles and microbial aerosol at home and symptom diary responses among teachers
(3) adjusted for the association between microenvironmental concentrations of particles and microbial aerosol at work and symptom diary responses among teachers
(4) Home inspection by trained building engineers includes 2 categories: no mold and visible mold. Moisture damage in 3 classes: Class 0 & 1 is damage with no need to repair or only cosmetic repair; Class 2 is a repair of surface materials; Class 3 is a repair of structural components; Class 4 & 5 are extensive repair. Major damage means: 1) need repair class 2 with area of damage >= $1m^2$; 2) need repair class 3 with area of damage >= $0.11m^2$; or 3) need repair class 4 or 5.

[a] Relative odds of morbidity
AF = Attributable Fraction (%)

A2.10. Respiratory infections and otitis media

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Cross-sectional studies				
(Bakke et al. 2007)	173 staff from 4 university buildings in Bergen, Norway	airway infection last month, from qx	dampness in the home, from qx	3.14 (1.01 to 9.80)*
(Haverinen et al. 2001)	1,017 adults who lived in selected dwellings for visible signs of moisture damage	sinusitis	2-level classification of dampness -- homes with visible mold growth or mold odor vs. those with neither	1.72 (1.09–2.73)
		otitis		1.21 (0.54–2.69)
		bronchitis		1.56 (0.96-2.52)
(Pirhonen et al. 1996)	1,460 adults age 25-64	sinusitis	dampness or mold (any of 4 indicators)	1.24 0.95-1.62
		otitis media		1.12 (0.66-1.89)
		pneumonia		2.3 (0.66-8.03)
		common cold		1.68 (0.96-1.21)
(Sun et al. 2009)	3,436 college students age 17-45 in China	common cold> 6 times in the last 12 mo, from qx	visible mold spot	1.72 (1.13 to 2.62)
			damp stain	1.47 (1.03 to 2.11)
			suspected moisture problem not visible on walls, ceiilings, and floors	1.36 (1.01 to 1.83)
			water damage	1.70 (1.11 to 2.62)
			water condensation on the inner windowpane in winter > 25cm	1.17 (0.76 to 1.81)
(Haverinen et al. 2001)	1,017 adults who lived in selected dwellings for visible signs of moisture damage	common cold	2-level classification of dampness -- homes with visible mold growth or mold odor vs. those with neither	0.98 (0.71–1.34)
Children				
Prospective studies				

Table A2.10 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Biagini et al. 2006)	663 infants enrolled in the Cincinnati Childhood Allergen and Air Pollution Study as of January 2004 and at least one parent was skin-prick test positive	upper respiratory infection first year of birth	Exposure to visible mould:	
			None	1.0
			Low	1.5 (1.1-2.3)
			High	5.1 (2.2-12.1)
(Pettigrew et al. 2004)	806 infants at high risk of asthma	First episode of otitis media <6 months of age	Mold	1.37 (0.91-2.02)
			Penicillium -- undetectable	1.00
			1-499 CFU/m3	0.75 (0.52-1.08)
			500-999 CFU/m3	1.89 (0.67-5.30)
			≥1000 CFU/m3	1.27 (0.56-2.86)
			Cladosporium -- undetectable	1.00
			1-499 CFU/m3	1.04 (0.70-1.56)
			500-999 CFU/m3	0.92 (0.48-1.79)
			≥1000 CFU/m3	1.09 (0.52-2.29)
			Other mold -- undetectable	1.00
			1-499 CFU/m3	1.21 (0.84-1.74)
			500-999 CFU/m3	0.72 (0.29-1.80)
			≥1000 CFU/m3	3.45 (1.36-8.76)
(Stark et al. 2003)*	499 children of parents with asthma or allergies	any lower respiratory illness (LRI)	Water damage or mold/ mildew	1.34 (0.99-1.82)
			Fungal exposure: high (in 90th percentile of distribution) vs. low	
			Airborne, *Aspergillus*	0.99 (0.58-1.68)
			Cladosporium	1.17 (0.77-1.77)
			Penicillium	1.73 (1.23-2.43)
			Yeasts	0.80 (0.47-1.38)

Table A2.10 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure		Risk Estimate
			Dust-borne,	*Alternaria*	1.51 (1.00-2.28)
				Aspergillus	0.94 (0.54-1.65)
				Aureobasidium	1.21 (0.76-1.93)
				Cladosporium	1.52 (1.02-2.25)
				Coelomyces	1.09 (0.66-1.79)
				Fusarium	1.28 (0.79-2.09)
				Penicillium	1.07 (0.61-1.86)
				Ulocladium	1.24 (0.83-1.85)
				Wallemia	0.92 (0.54-1.57)
				Yeasts	0.93 (0.55-1.57)
				Zygomycetes	1.96 (1.35-2.83)
		LRI without wheeze	Airborne,	*Aspergillus*	0.80 (0.26-2.44)
				Cladosporium	1.33 (0.61-2.91)
				Penicillium	3.32 (1.83-6.04)
				Yeasts	0.73 (0.28-1.91)
			Dust-borne,	*Alternaria*	1.12 (0.44-2.88)
				Aspergillus	1.80 (0.86-3.76)
				Aureobasidium	0.85 (0.28-2.56)
				Cladosporium	1.68 (0.78-3.60)
				Fusarium	1.13 (0.44-2.90)
				Penicillium	0.62 (0.16-2.43)
				Yeasts	1.77 (0.85-3.71)
				Zygomycetes	1.19 (0.47-3.00)
		LRI with wheeze	Water damage or mold / mildew		1.35 (0.90-2.04)
			Airborne,	*Aspergillus*	1.05 (0.55-2.01)
				Cladosporium	1.13 (0.64-2.00)
				Penicillium	1.56 (0.92-2.65)
				Yeasts	0.78 (0.38-1.60)
			Dust-borne,	*Alternaria*	1.82 (1.08-3.08)
				Aspergillus	0.47 (0.16-1.41)
				Aureobasidium	1.42 (0.80-2.50)

Table A2.10 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			Cladosporium	1.57 (0.91-2.69)
			Coelomyces	0.82 (0.36-1.88)
			Fusarium	1.35 (0.71-2.57)
			Penicillium	1.28 (0.67-2.47)
			Ulocladium	1.33 (0.76-2.35)
			Wallemia	0.46 (0.15-1.36)
			Yeasts	0.53 (0.21-1.35)
			Zygomycetes	2.60 (1.63-4.16)
(Muller et al. 2002)	475 premature and atopic risk newborns	respiratory tract infections	Indoor exposure to *Penicillium* spores >100 CFU/m^3	6.88 (1.21-38.9)
(Diez et al. 2003)	186 children age 1-2 in Germany whose apartments were redecorated during this period	obstructive bronchitis during 1st year of life	dampness in the apartment	2.0 (0.8 to 5.0)
		obstructive bronchitis during 2nd year of life	dampness in the apartment	1.0 (0.3 to 3.7)
(Karvonen et al. 2009)	396 children followed from birth to 18 months, half from rural areas of Finland in PASTURE study, half from Kuopio Univ Hospital	otitis, from qx	moisture damage with major need for repair, any in whole house (1)	0.85 (0.48 to 1.49)
			indoor mold odor, any in whole house	1.10 (0.44 to 2.77)
			visible indoor mold, any in whole house	0.57 (0.32 to 1.02)
			major moisture damage in the kitchen (1)	1.04 (0.40 to 2.71)
			mold in the kitchen	0.82 (0.44 to 1.51)
			major moisture damage in the main living area (1)	1.40 (0.73 to 2.67)
			mold in the main living area	1.01 (0.48 to 2.13)
			moisture damage in the child's bedroom	0.63 (0.34 to 1.16)
			mold in the child's bedroom	2.20 (0.65 to 7.46)
(Karvonen et al. 2009)	396 children followed from birth to 18 months, half from rural areas of Finland in PASTURE study, half from Kuopio Univ Hospital	common coldwithout fever at 12 to 18 mo, > 2 vs =< 2 episodes, from qx	moisture damage with major need for repair, any in whole house (1)	0.57 (0.30 to 1.11)
			indoor mold odor, any in whole house	1.12 (0.40 to 3.16)
			visible indoor mold, any in whole house	0.72 (0.35 to 1.46)

Table A2.10 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			major moisture damage in the kitchen (1)	0.49 (0.13 to 1.80)
			mold in the kitchen	0.45 (0.20 to 0.99)
			major moisture damage in the main living area (1)	1.06 (0.51 to 2.19)
			mold in the main living area	1.23 (0.54 to 2.78)
			moisture damage in the child's bedroom	0.86 (0.42 to 1.78)
Cross-sectional studies				
(du Prel et al. 2006)	22,666 children age 6 in East Germany	> 4 colds in past 12 months	Damp housing conditions	1.41 (1.25–1.60)
	6,222 children age 6 in West Germany	> 4 colds in past 12 months	Damp housing conditions	1.62 (1.21-2.17)
(Karevold et al. 2006)	3,406 children age 10 living in Oslo, Norway	otitis media	Home dampness	1.2 (1.0-1.5)
		lower respiratory tract infections		1.3 (1.0-1.7)
(Spengler et al. 2004)	5,951 children age 8-12 in 8 Russian cities	current acute upper respiratory infection	Water damage in last 12 mo	1.23 (0.98-1.55)
			Presence of molds in last 12 mo	1.74 (1.35-2.25)
(Yang et al. 1997b)	4,164 primary school children age 6-12 in Kaohsiung rural	pneumonia	Home dampness	1.85 (0.94-3.61)
(Nafstad et al. 2005)	942 children age 3-5 in Oslo, who attend daycare centres	common cold	Dampness problems	1.08 (0.64-1.81)
		pharyngitis or tonsillitis		0.98 (0.67-1.42)
		otitis media		1.00 (0.70-1.43)
		bronchitis		1.52 (0.78-2.96)
		pneumonia		0.65 (0.26-1.62)
(Yang et al. 1999)	219 school children age 6-12 and 219 age- and gender-matched controls in Taiwan	dr-dx oitis media in the previous year, from qx	mold = visible mold or mildew growth on surfaces inside the home, from qx	1.64 (1.08 to 2.47)*
			flooding = appearance of standing water within the home, water damage, or water leaks, from qx	2.20 (1.48 to 3.28)*
			home dampness (presence of either mold or flooding), from qx	2.11 (1.41 to 3.19)*

Table A2.10 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Li and Hsu 1996) 1996)	1,340 children age 8-12 in the Taipei area	pneumonia	Parental-determined dampness	1.33 (0.75-2.36)
			Dampness (mold, water damage, or flooding)	1.30 (0.67-2.52)
			Visible mold	1.77 (1.03-3.05)
			Stuffy odor	1.17 (067-2.04)
			Water damage or leaks	0.79 (0.18-3.49)
			Flooding	1.71 (0.89-3.29)
(Zhao et al. 2008)	1,993 children age 11-15 from 10 randomly selected schools in Taiyuan, China	resp infections in the last 3 mo, from qx	muramic acid, per 10 ug/g in vacuumed classroom dust	0.74 (0.57 to 0.96)*
			ergosterol, per ug/g in vacuumed classroom dust	1.40 (1.06 to 1.84)*
			LPS, per 10 nmol/g in vacuumed classroom dust	1.09 (0.91 to 1.31)
			C10 3-OH FA per 10 nmol/g in vacuumed classroom dust	0.78 (0.42 to 1.73)
			C18 3-OH FA per 10 nmol/g in vacuumed classroom dust	1.02 (0.95 to 1.10)
Children and adults				
Cross-sectional studies				
(van Gageldonk-Lafeber et al. 2007)	493 pairs of cases and controls in matched age groups (0-4, 5-14, 15-24, 25-44, 45-64, >= 65) from the Netherlands	consulting a GP with an acute respiratory tract infection	dampness or mold at home, from qx	0.48 (0.23 to 1.00)
		lab-confirmed acute respiratory tract infection with 1+ pathogens detected from nose and mouth swabs	dampness or mold at home, from qx	0.60 (0.31 to 1.18)

* For Stark et al., 2003, LRI was defined in the question: "Since we last spoke on (date given), has your child had a pneumonia, croup, bronchitis, or bronchiolitis diagnosed by a doctor?" The primary outcome variable was at least one report of LRI in the first year of life.
(1) Home inspection by trained building engineers includes 2 categories: no mold and visible mold. Moisture damage in 3 classes: Class 0 & 1 is damage with no need to repair or only cosmetic repair; Class 2 is a repair of surface materials; Class 3 is a repair of structural components; Class 4 & 5 are extensive repair. Major damage means: 1) need repair class 2 with area of damage >= $1m^2$; 2) need repair class 3 with area of damage >= $0.11m^2$; or 3) need repair class 4 or 5.

A2.11. Common Cold

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Cross-sectional studies				
(Haverinen et al. 2001)	1,017 adults who lived in selected dwellings for visible signs of moisture damage	common cold	2-level classification of dampness -- homes with visible mold growth or mold odor vs. those with neither	0.98 (0.71–1.34)
(Pirhonen et al. 1996)	1,460 adults age 25-64	common cold	dampness or mold (any of 4 indicators)	1.68 (0.96-1.21)
(Sun et al. 2009)	3,436 college students age 17-45 in China	common cold> 6 times in the last 12 mo, from qx	visible mold spot	1.72 (1.13 to 2.62)
			damp stain	1.47 (1.03 to 2.11)
			suspected moisture problem not visible on walls, ceiilings, and floors	1.36 (1.01 to 1.83)
			water damage	1.70 (1.11 to 2.62)
			water condensation on the inner windowpane in winter > 25cm	1.17 (0.76 to 1.81)
Children				
Prospective studies				
(Karvonen et al. 2009)	396 children followed from birth to 18 months, half from rural areas of Finland in PASTURE study, half from Kuopio Univ Hospital	common coldwithout fever at 12 to 18 mo, > 2 vs =< 2 episodes, from qx	moisture damage with major need for repair, any in whole house (1)	0.57 (0.30 to 1.11)
			indoor mold odor, any in whole house	1.12 (0.40 to 3.16)
			visible indoor mold, any in whole house	0.72 (0.35 to 1.46)
			major moisture damage in the kitchen (1)	0.49 (0.13 to 1.80)
			mold in the kitchen	0.45 (0.20 to 0.99)
			major moisture damage in the main living area (1)	1.06 (0.51 to 2.19)
			mold in the main living area	1.23 (0.54 to 2.78)
			moisture damage in the child's bedroom	0.86 (0.42 to 1.78)
			mold in the child's bedroom	1.77 (0.57 to 5.57)
Cross-sectional studies				

Table A2.11 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(du Prel et al. 2006)	22,666 children age 6 in East Germany	> 4 colds in past 12 mo	Damp housing conditions	1.41 (1.25–1.60)
	22,666 children age 6 in West Germany	> 4 colds in past 12 mo	Damp housing conditions	1.62 (1.21-2.17)
(Nafstad et al. 2005)	942 children age 3-5 in Oslo, who attend daycare centres	common cold	Dampness problems	1.08 (0.64-1.81)
(Spengler et al. 2004)	5,951 children age 8-12 in 8 Russian cities	acute upper respiratory infection	water damage	1.23 (0.98-1.55)
			presence of molds	1.74 (1.35-2.25)

(1) Home inspection by trained building engineers includes 2 categories: no mold and visible mold. Moisture damage in 3 classes: Class 0 & 1 is damage with no need to repair or only cosmetic repair; Class 2 is a repair of surface materials; Class 3 is a repair of structural components; Class 4 & 5 are extensive repair. Major damage means: 1) need repair class 2 with area of damage >= $1m^2$; 2) need repair class 3 with area of damage >= $0.11m^2$; or 3) need repair class 4 or 5.

A2.12 Eczema

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Cross-sectional studies				
(Sun et al. 2009)	3,436 college students age 17-45 in China	eczema, from qx	visible mold spot	1.29 (0.83 to 2.00)
			damp stain	1.27 (0.87 to 1.84)
			suspected moisture problem not visible on walls, ceiilings, and floors	1.48 (1.07 to 2.05)
			water damage	1.40 (0.87 to 2.24)
			water condensation on the inner windowpane in winter > 25cm	1.38 (0.86 to 2.23)
Children				
Prospective studies				
(Miyake et al. 2007)	865 Japanese infants under 1 yr	dx or suspected atopic eczema in first year, from maternal qx	mold in kitchen during pregnancy, from maternal qx	1.86 (1.08-3.15)
			mold in kitchen during pregnancy, from maternal qx	with no parental atopic history: 2.93 (1.27-6.75)
			mold in kitchen during pregnancy, from maternal qx	with parental atopic history: 1.23 (0.55-2.56)
(Perzanowski et al. 2006)	301 children of Dominican or African American mothers in New York City	eczema at age 2 yr	endotoxin in floor dust samples in bedrooms at age 12 mo (for 47 children, at 36 mo); ORs for EU/mg dust	0.86 (0.64-1.2)
		eczema at age 3 yr		0.74 (0.52-1.05)
Cross-sectional studies				
(Hagerhed-Engman et al. 2009)	198 cases and 202 controls chosen through 2 qxs from children age 3-8 in Sweden	dr-dx eczema	severe moldy odor in home and/or at least 1 room, from inspection	0.76 (0.36 to 1.61)

Table A2.12 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			severe moldy odor along the skirting board in at least 1 room, from inspection	1.93 (0.91 to 4.12)
			severe visible spots of mold, stain of dampness or discolored stains on walls & ceiling in at least 1 room, from inspection	0.30 (0.06 to 1.57)
(Pirastu et al. 2009)	3,455 children age 5-12 in villages southwest of Italy	eczema, from qx	observable mold, dampness, or fungi on the walls or ceiling of the child's bedroom in 1st year of the child's life (early), from qx	1.30 (0.88 to 1.92)
			observable mold, dampness, or fungi on the walls or ceiling of the child's bedroom recently (current), from qx	1.34 (0.90 to 2.00)
			observable mold, dampness, or fungi on the walls or ceiling of the child's bedroom in the frst year of the child's life and recently (both), from qx	1.04 (0.65 to 1.65)
(Tham et al. 2007)	4,759 children age 1.5-6 in 120 day-care centers in Singapore	eczema in the past 12 mo, from qx	visible damp stains on the floor, walls, or ceilings in the room the child sleeps, from qx	1.23 (0.85 to 1.76)
		flexural rash in the past 12 mo		1.27 (0.86 to 1.86)
		eczema in the past 12 mo, from qx	visible mold on the floor, walls, or ceilings in the room the child sleeps, from qx	1.28 (0.83 to 1.97)
		flexural rash in the past 12 mo		1.15 (0.70 to 1.88)

A2.13. Allergy/Atopy (excluding allergic rhinitis and eczema)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Prospective studies				
(Matheson et al. 2005)	845 adults age 20-45from the southeastern suburbs of Melbourne	atopy	Ergosterol in floor dust[a]	1.38 (0.93-2.04)
			Total fungi, culturable airborne[a]	1.53 (1.00-2.32)
			Cladosporium, culturable airborne[a]	1.05 (0.89-1.25)
			Other fungi, culturable airborne[a]	1.17 (0.94-1.45)
Cross-sectional studies				
(Dharmage et al. 2001)	485 participants in a follow-up study to the European Community Respiratory Health Survey (ECRHS)	"risk of being sensitized to fungi"	Ergosterol levels -- upper three quartiles compared with the first quartile	range 2.4-2.7
			Penicillium -- upper three quartiles compared with the first quartile	range 0.5-0.8
			Cladosporium -- upper three quartiles compared with the first quartile	range 0.4-0.9
(Rennie et al. 2005)	1,998 adults age 18-74	"men, allergy"	Damp housing	1.44 (0.84-2.45)
		"women, allergy"		1.53 (1.05-2.24)
(Norbäck et al. 1999)	455 adults. 98 prevalent cases of asthma and 357 controls	increase in blood eosinophil concentration × 10^6/L	Water damage or flooding	45 (11-79)
		increase in serum ECP[a] in µg/L		1.0 (-1.2-3.2)
		increase in blood eosinophil concentration × 10^6/L	Dampness in the floor	27 (-25-79)

Table A2.13 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		increase in serum ECP[a] in µg/L		-2.1 (-5.6-1.4)
		increase in blood eosinophil concentration × 10^6/L	Visible mold on indoor surfaces	11 (-30-52)
		increase in serum ECP[a] in µg/L		-0.9 (-3.6-1.8)
		increase in blood eosinophil concentration × 10^6/L	Moldy odor	-45 (-7-97)
		increase in serum ECP[a] in µg/L		-2.7 (-6.3-0.9)
		increase in blood eosinophil concentration × 10^6/L	At least one sign of building dampness	41(2-60)
		increase in serum ECP[a] in µg/L		0.5 (-0.4-3.4)
Children				
Prospective studies				
(Muller et al. 2002)	475 premature and atopic risk newborns	"increased levels of specific IgE against grass"	*Aspergillus* exposure>100 CFU/m^3	5.28 (1.02-27.1)
(Douwes et al. 2006)	696 children with atopic mothers	atopy at 4 years	EPS-*Pen*/*Asp*	0.40 (0.18-0.91)
		"atopy at 1 year		No association found (data not shown)
		"atopy at 4 years"	EPS-*Pen*/*Asp*, fungal glucan, endotoxin	No association found (data not shown)
(Cho et al. 2006)	640 infants of at least one atopic parent	positive SPT to	Class of mold damage --	

Table A2.13 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		mold	no damage	RR = 1.0
			minor damage	RR = 1.6 (0.9-3.0)
			major damage	RR = 0.6 (0.1-4.0)
		positive SPT to aeroallergens	Class of mold damage --	
			no damage	RR = 1.0
			minor damage	RR = 0.9 (0.6-1.2)
			major damage	RR = 1.6 (0.9-3.0)
(Karvonen et al. 2009)	396 children followed from birth to 18 months, half from rural areas of Finland in PASTURE study, half from Kuopio Univ Hospital	sensitization to cat dander, from venous blood sample of IgE	major moisture damage in the kitchen (1)	2.18 (0.72 to 6.64)
			mold in the kitchen	1.64 (0.78 to 3.45)
			major moisture damage in the main living area (1)	0.99 (0.43 to 2.30)
			mold in the main living area	1.44 (0.61 to 3.38)
			moisture damage in the child's bedroom	1.81 (0.89 to 3.66)
			mold in the child's bedroom	2.42 (0.74 to 7.91)
			moisture damage in the bathroom	1.98 (0.96 to 4.06)
			mold in the bathroom	2.01 (1.04 to 3.89)
(Bolte et al. 2003)	1942 infants in pospective cohort at 2 years old	sensitzation to food allergens by specific IgE	endotoxin in mother's mattress dust at age 3 mo, 4th quartile vs. 1st	0.66 (0.40-1.10)
		sensitzation to inhalant allergens by specific IgE		1.36 (0.65-2.83);
		dr dx atopic dermatitis		1.04 (0.73-1.47)
(Gillespie et al. 2006)	881 New Zealand infants followed from birth	atopy to any of 10 inhalant or food antigens by SPT @ 15 mo	endotoxin (EU/g) in bedroom floor dust at age 3 mo, 4^{th} quartile vs. 1^{st}	0.73 (0.45-1.19)
Cross-sectional studies				
(Schafer et al. 1999)	1,235 children from two West and five East German locations	"skin prick test reactivity to *Alternaria*"	Dampness and visible mold	1.65 (0.69-3.93)

Table A2.13 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
(Spengler et al. 2004)	5,951 children age 8-12 in 8 Russian cities	any allergy	Water damage	1.26 (1.05-1.52)
		respiratory allergy		1.30 (0.95-1.77)
		any allergy	Presence of molds	1.51 (1.25-1.82)
		respiratory allergy		1.50 (1.11-2.02)
(Jovanovic et al. 2004)	397 children. 199 children with allergic history and 198 controls without allergic history	serum IgE against fungi	Measured mold	No association
(du Prel et al. 2006)	22,666 children age 6 in East Germany	allergy, ever diagnosed	Damp housing conditions	1.09 (0.93-1.28)
	6,222 children age 6 in West Germany	allergy, ever diagnosed	Damp housing conditions	1.20 (0.87-1.66)
(Bakke et al. 2007)	173 staff from 4 university buildings in Bergen, Norway	atopy (by Phadiotop)	dampness in the home, from qx	1.88 (0.72-4.89)
(Schram-Bijkerk et al. 2005)	899 children age 5-13 from Austria, Germany, the Netherlands, Sweden, and Switzerland, including 168 current atopic wheezers and 441 controls	atopic wheeze in Steiner and Steiner-reference children, from qx	endotoxin, interquartile range increase, from vacuumed mattresses and living room floors	1.22 (0.84-1.77)
		current atopic wheeze in Steiner and Steiner-reference children in the last 12 mo, from qx		1.38 (0.92-2.09)
		atopic wheeze in Steiner and Steiner-reference children, from qx	EPS, interquartile range increase, from vaccummed mattresses and living room floors	0.96 (0.74-1.25)
		current atopic wheeze in Steiner and Steiner-reference children in the last 12 mo, from qx		0.89 (0.67-1.18)

Table A2.13 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		atopic wheeze in Steiner and Steiner-reference children, from qx	glucans, interquartile range increase, from vaccummed mattresses and living room floors	0.92 (0.66-1.28)
		current atopic wheeze in Steiner and Steiner-reference children in the last 12 mo, from qx		0.80 (0.56-1.16)
(Zhao et al. 2008)	1,993 children age 11-15 from 10 randomly selected schools in Taiyuan, China	a history of atopy	muramic acid, per 10 ug/g in vacuumed classroom dust	0.81 (0.37 to 1.75)
			ergosterol, per ug/g in vacuumed classroom dust	0.50 (0.23 to 1.09)
			LPS, per 10 nmol/g in vacuumed classroom dust	1.13 (0.72 to 1.76)
			C10 3-OH FA per 10 nmol/g in vacuumed classroom dust	0.36 (0.06 to 2.06)
			C18 3-OH FA per 10 nmol/g in vacuumed classroom dust	1.13 (0.94 to 1.35)
(Gehring et al. 2008)	840 children, ages 9-12 yr old, from five European countries	atopy by specific IgE	endotoxin concentration in living room floor dust, per interquartile range	0.88 (0.69-1.11)
Adults and children				
Cross-sectional studies				
(Salo et al. 2006)	2456 individuals (adults and children) living in non-institutional housing units that permit resident children	diagnosed hay fever	*Alternaria alternata* concentration in dust, adjusted model,	
			1st tertile	1.00
			2nd tertile	1.04 (0.71-1.51)
			3rd tertile	0.92 (0.65-1.31)

Table A2.13 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			Alternaria alternata concentration in dust, adjusted model including other indoor allergens,	
			1st tertile	1.00
			2nd tertile	1.04 (0.71-1.53)
			3rd tertile	0.91 (0.61-1.37)
			Alternaria alternata concentration in dust, adjusted model including other indoor allergens and dust weight,	
			1st tertile	1.00
			2nd tertile	1.03 (0.70-1.51)
			3rd tertile	0.89 (0.59-1.35)
			Alternaria alternata concentration in dust, adjusted model including other indoor allergens, dust weight and endotoxin,	
			1st tertile	1.00
			2nd tertile	1.07 (0.73-1.58)
			3rd tertile	0.98 (0.64-1.51)

[a] ECP = eosinophilic cationic protein
RR = Relative Risk
(1) Home inspection by trained building engineers includes 2 categories: no mold and visible mold. Moisture damage in 3 classes: Class 0 & 1 is damage with no need to repair or only cosmetic repair; Class 2 is a repair of surface materials; Class 3 is a repair of structural components; Class 4 & 5 are extensive repair. Major damage means: 1) need repair class 2 with area of damage >= $1m^2$; 2) need repair class 3 with area of damage >= $0.11m^2$; or 3) need repair class 4 or 5.

A2.14. Allergic Rhinitis

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Children				
Prospective studies				
(Biagini et al. 2006)	633 infants enrolled in the Cincinnati Childhood Allergen and Air Pollution Study as of January 2004 and at least one parent was skin-prick test positive	Allergic rhinitis by parental sx report plus 1+ positive SPT at age 1 yr	Exposure to visible mold:	
			None	1.0
			Low	1.2 (0.6-2.5)
			High	3.2 (0.7-14.8)
(Stark et al. 2005)	405 children of parents with asthma/allergies from metropolitan Boston, Massachusetts	Allergic rhinitis, dr-dx by parental report	Fungal exposure: high (in 90th percentile of distribution) vs. low	
			Airborne, *Aspergillus*	1.10 (0.43-2.80)
			Airborne, *Cladosporium*	1.25 (0.43-3.64)
			Airborne, non-sporulating	0.55 (0.17-1.81)
			Airborne, *Penicillium*	0.69 (0.23-2.06)
			Airborne, Yeasts	0.79 (0.24-2.60)
			Total airborne, cfu/m^3	0.83 (0.28-2.43)
			Dust-borne, *Alternaria*	2.34 (1.12-4.91)
			Dust-borne, *Aspergillus*	2.57 (1.22-5.40)
			Dust-borne, *Aureobasidium*	3.12 (1.50-6.50)
			Dust-borne, *Cladosporium*	1.88 (0.81-4.35)
			Dust-borne, *Coelomyces*	0.93 (0.36-2.38)
			Dust-borne, *Fusarium*	1.81 (0.76-4.34)
			Dust-borne, non-sporulating	2.45 (1.15-5.22)
			Dust-borne, *Penicillium*	1.51 (0.63-3.64)
			Dust-borne, *Ulocladium*	1.04 (0.37-2.95)
			Dust-borne, *Wallemia*	1.73 (0.80-3.75)
			Dust-borne, Yeasts	2.90 (1.37-6.09)
			Dust-borne, *Zygomycetes*	0.87 (0.31-2.44)
			Total dust-borne,	3.13 (1.51-6.47)

Table A2.14 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			Water damage or mold/mildew in year 1, model 1[a]	1.66 (0.88-3.15)
			Water damage or mold/mildew in year 1, model 2[b]	1.77 (0.94-3.34)
			Water damage or mold/mildew in year 1, model 3[c]	1.66 (0.87-3.17)
			Dust-borne *Alternaria,* model 1[a]	1.40 (0.61-3.23)
			Dust-borne *Alternaria,* model 2[b]	1.52 (0.67-3.44)
			Dust-borne *Alternaria,* model 3[c]	2.07 (0.98-4.37)
			Dust-borne *Aspergillus,* model 1[a]	3.27 (1.50-7.14)
			Dust-borne *Aspergillus,* model 2[b]	2.93 (1.36-6.30)
			Dust-borne *Aspergillus,* model 3[c]	2.73 (1.27-5.87)
			Dust-borne *Aureobasidium,* model 1[a]	3.04 (1.33-6.93)
			Dust-borne *Aureobasidium,* model 2[b]	3.06 (1.35-6.91)
			Dust-borne yeasts, model 1[a]	2.67 (1.26-5.66)
			Dust-borne yeasts, model 2[b]	2.80 (1.33-5.93)
			Dust-borne yeasts, model 3[c]	2.52 (1.18-5.36)
Cross-sectional studies				
(Li and Hsu 1997)	46 children aged 7 to 15 years	allergic rhinitis, dr dx	Parental-reported dampness	3.50 (1.00-12.34)
			Mold	3.50 (1.00-12.34)
			Water damage	0.73 (0.23-2.37)
			Stuffy odor	2.73 (0.77-9.69)
			Flooding	1.92 (0.38-9.76)
			Dampness	2.09 (0.47-9.38)
(Dong et al. 2008a)	10,784 children age 6-13 from urban areas in northeast China	allergic rhinitis, dr dx by parental report	mold in the past 12 mo (signs of flooding, water damage or mold growth in the home)	1.21 (0.97 to 1.50)
(Hsu et al. 2009)	1,368 children age 6-13 in urban Taipei	allergic rhinitis, by medical exam and parental report, with nasal sxs more than 12 mo,	mold exposure, from qx (measurement not described)	1.30 (0.96 to 1.75)

Table A2.14 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		history of allergic triggering, and pale nasal mucosa		

[a]full variate model
[b]multivariate model omitting any lower respiratory infection in year 1
[c]multivariate model omitting dust-borne *Aureobasidium*
Abbreviations: HR, Hazard Ratio; SPT, skin prick test

A2.15. Upper respiratory tract symptoms (including allergic rhinitis; also include entries in Table A2.14. Allergic rhinitis)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Cross-sectional studies				
(Sun et al. 2009)	3,436 college students age 17-45 in China	rhinitis, from qx	visible mold spot	1.06 (0.87 to 1.38)
			damp stain	1.07 (0.87 to 1.32)
			suspected moisture problem not visible on walls, ceiilings, and floors	1.05 (0.88 to 1.25)
			water damage	1.28 (0.97 to 1.70)
			water condensation on the inner windowpane in winter > 25cm	1.18 (0.91 to 1.52)
(Thorn and Rylander 1998)	129 adults age 18-83	Itchy nose	Airborne **(1-3)**-ß-D-**glucan (**while disturbing settled dust) --	
			>2-4 ng/m^3	2.18 (0.90-5.27)
			>4 ng/m^3	1.27 (0.62-2.58)
		Irritation in the throat	>2-4 ng/m^3	1.04 (0.70-1.55)
			>4 ng/m^3	0.97 (0.67-1.41)
(Haverinen et al. 2001)	1017 adults who lived in selected dwellings for visible signs of moisture damage		2-level classification of dampness: Homes with visible mold growth or mold odor, vs. neither	
		prolonged rhinitis		1.00 (0.73-1.35)
		impaired sense of smell		1.35 (0.66-2.76)[a]
		nasal bleeding		0.51 (0.18-1.47)
		sore throat		1.27 (0.64-2.51)
		hoarseness		1.59 (0.82-3.07)
			3-level classification of dampness	

Table A2.15 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		prolonged rhinitis	Grade I (No visible moisture damage; minor moisture damage; one patch of deteriorated interior finish or covering, which needed drying, re-gluing or fixing)	1.00
		impaired sense of smell		1.00
		nasal bleeding		1.00
		sore throat		1.00
		hoarseness		1.00
		prolonged rhinitis	Grade II (Single observation of a damaged interior structural component that needed opening, drying and renewal or minor repair; single patch of deteriorated interior finish or covering, as in Grade I, plus other damage of the same or lower level of severity, but not higher)	1.05 (0.71-1.55)
		impaired sense of smell		1.09 (0.44-2.67)
		nasal bleeding		0.73 (0.18-2.88)
		sore throat		1.64 (0.74-3.63)
		hoarseness		1.38 (0.61-3.13)
		prolonged rhinitis	Grade III (The presence of a damaged interior structural component , as in Grade II, together with other damage of the same level of severity or less; A functional element that needed partial or total renewal, together with or without the presence of other damage)	1.03 (0.68-1.57)
		impaired sense of		0.88 (0.34-2.33)

Table A2.15 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		smell		
		nasal bleeding		0.83 (0.20-3.36)[a]
		sore throat		1.09 (0.45-2.65)
		hoarseness		2.06 (0.88-4.84)[ab]
(Haverinen-Shaughnessy et al. 2007)	81 randomly selected elementary school teachers	Blocked nose today, from diary	Airborne, personal samples	
			Total fungi	1.26 (0.87-1.83)
			Viable fungi, MEA	0.91 (0.70-1.18)
			Viable fungi, DG18	0.96 (0.76-1.22)
			Total bacteria	1.79 (1.18-2.70)
			Viable bacteria	1.18 (0.83-1.67)
			Airborne, home	
			Total fungi	1.05 (0.75-1.45)
			Viable fungi, MEA	0.79 (0.63-0.99)
			Viable fungi, DG18	0.81 (0.65-1.01)
			Total bacteria	1.09 (0.85-1.39)
			Viable bacteria	0.96 (0.77-1.21)
			Airborne, work	
			Total fungi	1.02 (0.64-1.62)
			Viable fungi, MEA	0.95 (0.61-1.47)
			Viable fungi, DG18	0.81 (0.50-1.31)
			Total bacteria	1.14 (0.87-1.49)
			Viable bacteria	1.05 (0.79-1.38)
		Sore throat this week	Airborne, personal samples	
			Total fungi	0.54 (0.33-0.89)
			Viable fungi, MEA	0.75 (0.56-1.01)
			Viable fungi, DG18	0.69 (0.49-0.97)
			Total bacteria	0.87 (0.53-1.41)
			Viable bacteria	1.13(0.69-1.84)
			Airborne, home	
			Total fungi	0.87 (0.60-1.25)
			Viable fungi, MEA	0.70 (0.52-0.95)

Table A2.15 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			Viable fungi, DG18	0.81 (0.63-1.03)
			Total bacteria	0.80 (0.60-1.07)
			Viable bacteria	1.00 (0.68-1.47)
			Airborne, work	
			Total fungi	1.03 (0.62-1.71)
			Viable fungi, MEA	1.13 (0.76-1.68)
			Viable fungi, DG18	0.95 (0.68-1.44)
			Total bacteria	0.85 (0.65-1.37)
			Viable bacteria	0.92 (0.61-1.37)
(Park et al. 2004)	323 employees in 13 college buildings	nasal symptoms	Water stains, continuous variable	1.5 (0.8-2.8)
		sinus symptoms		1.6 (0.9-2.9)
		throat irritation		2.4 (1.3-4.4)
		nasal symptoms	Water stains, any stains	4.4 (1.2-15.3)
		sinus symptoms		3.8 (1.1-13.4)
		throat irritation		2.0 (0.7-5.6)
		nasal symptoms	Any visible mold	1.7 (1.0-3.0)
		sinus symptoms		2.0 (1.2-3.4)
		throat irritation		1.3 (0.7-2.1)
		nasal symptoms	Any mold odor	1.1 (0.6-2.1)
		sinus symptoms		1.3 (0.7-2.5)
		throat irritation		2.3 (1.2-4.3)
		nasal symptoms	Any damp material or standing water	1.7 (0.5-6.0)
		sinus symptoms		0.8 (0.2-2.9)
		throat irritation		1.5 (0.4-5.1)
		nasal symptoms	Factor combinations, water-stain-weighted	2.4 (1.3-4.6)
		sinus symptoms		1.8 (1.0-3.4)
		throat irritation		1.6 (0.9-3.0)
		nasal symptoms	Factor combinations, visible-mold-weighted	2.5 (1.3-4.7)
		sinus symptoms		2.2 (1.2-4.1)
		throat irritation		1.5 (0.8-2.8)
(Park et al. 2006)	888 occupants of a water-damaged building	throat irritation	Fungi [c]	1.4 (0.93-2.09)
			Fungi (high), Endotoxin (low) [d]	1.5 (0.77-3.01)

Table A2.15 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			Fungi (low), Endotoxin (high) [d]	1.6 (0.79-3.34)
			Fungi (high), Endotoxin (high) [d]	2.2 (1.20-3.90)
(Bakke et al. 2007)	173 university staff from four university buildings in Bergen	nasal symptoms	Building dampness	0.42 (0.11-1.65)
		dry throat		0.80 (0.17-3.72)
(Dales et al. 1991)	14799 parents of school-aged children (aged between 5 and 8) in six regions of Canada	upper respiratory symptoms	Dampness/mold	1.50 (1.30-1.61)
(Ruotsalainen et al. 1995)	268 female day-care workers in Espoo, Finland	mucosal symptoms	Low exposure to water damage, no mold odor	0.55 (0.26-1.17)
		allergic symptoms		0.41 (0.19-0.89)
		mucosal symptoms	High exposure to water damage and mold odor	1.63 (0.69-3.84)
		allergic symptoms		1.66 (0.71-3.89)
(Bakke et al. 2007)	173 university staff from 4 university buildings in Bergen, Norway	nasal sx, weekly in the last 3 mo, from qx	dampness in the home, from qx	0.42 (0.11 to 1.65)
		dry throat, weekly in the last 3 mo, from qx		0.80 (0.17 to 3.72)
(Cox-Ganser et al. 2009)	1,171 workers in sentinel cases hospital or nearby control hospital in western U.S.	Work-related nasal and sinus sxs – last 12 mo last 4 wks	Airborne –culturable fungi, culturable bacteria, fungal spores, and endotoxin	All exposures positively associated with symptoms at both time periods 1.6 (1.3-3.7) for top vs. bottom quartile of endotoxin; dose-response for ergosterol
			Dust (floor or chair) –culturable fungi, culturable bacteria, fungal spores, and endotoxin, 75th vs. 25th percentile	Most exposures not significantly associated with symptoms at both time periods,

Table A2.15 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
				except -- Ergosterol in floor dust, 1.36 (0.9701.91) for last 12 wks and 1.42 (1.01-2.01) for last 4 wks, with positive dose-response over exposure quartiles for both 4 wks and 12 mo; For EPS Pen/Asp, 1.25 (1.0101.54) for last 12 mo
Children				
Prospective studies				
(Perzanowski et al. 2006)	301 children of Dominican or African American mothers in New York City	sxs of allergic rhinitis (sneezing or itchy eyes without a cold) at age 2 yrs	endotoxin in floor dust samples in bedrooms at age 12 mo (for 47 children, at 36 mo); ORs for EU/mg dust	0.98 (0.77-1.30)
		sxs of allergic rhinitis at age 3 yrs		1.08 (0.80-1.50)
(Simoni et al. 2005)	20,016 children (mean age 7 years)	Children, rhino-conjunctivitis	Mold/dampness – never	1.00
			current only	1.03 (0.72-1.49)
			early only (1st yr of life)	1.46 (1.13-1.89)
			both current and early	1.46 (1.01-2.09)
	13,266 adolescents (mean age 13 years)	Adolescents,	Mold/dampness – never	1.00

Table A2.15 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
		rhino-conjunctivitis		
			current only	1.10 (0.86-1.40)
			early only (1st yr of life)	1.15 (0.90-1.47)
			both current and early	1.78 (1.30-2.45)
(Gillespie et al. 2006)	881 New Zealand infants followed from birth	rhinitis by maternal qx at 15 mo	endotoxin (EU/g) in bedroom floor dust at age 3 mo, 4th quartile vs 1st	0.94 (0.60-1.46)
Retrospective studies				
(Andriessen et al. 1998)	1614 children who were positive to symptoms of asthma and chronic cough	"prevalence of upper respiratory symptoms"	Moisture stains	1.03 (0.91-1.17)
			Molds	1.00 (0.86-1.16)
Cross-sectional studies				
(Li and Hsu 1996)	1340 children (aged 8 to 12 years) in the Taipei area	allergic rhinitis (parental report of sneezing, nasal congestion, or itching nose without a cold)	Parental-reported dampness	1.39 (1.05-1.84)
			Dampness	1.56 (1.11-2.18)
			Mold	1.56 (1.11-2.18)
			Stuffy odor	1.37 (1.03-1.83)
			Water damage	1.47 (0.73-2.97)
			Flooding	1.55 (1.08-2.23)
(Yang et al. 1997a)	4164 primary school children, aged 6 to 12 years, in Kaohsiung rural areas in Taiwan	allergic rhinitis (parental report of sneezing, nasal congestion, or itching nose without a cold)	Home dampness	1.52 (1.25-1.85)
(Gehring et al. 2008)	840 children, ages 9-12 yr old, from five European countries	Hayfever by parental report	endotoxin concentration in living room floor dust, per interquartile	1.04 (0.59-1.84)

Table A2.15 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			range	
(Bornehag et al. 2005)	10,851 preschool children (ages 1-6) in Sweden	rhinitis last 12 months	Water leakage	1.35 (1.12-1.62)
		rhinitis (doctor-diagnosed)		1.23 (0.83-1.82)
		rhinitis last 12 months	Floor moisture	1.75 (1.39-2.21)
		rhinitis (doctor-diagnosed)		1.46 (0.88-2.41)
		rhinitis last 12 months	Visible dampness	1.67 (0.94-2.96)
		rhinitis (doctor-diagnosed)		2.95 (1.15-7.59)
		rhinitis last 12 months	Condensation on window	1.60 (1.32-1.94)
		rhinitis (doctor-diagnosed)		1.49 (1.00-2.23)
(Kuyucu et al. 2006)	2774 Turkish children aged 9 to 11 years	current rhinitis	Dampness/mold at 1 yr of age	1.70 (1.25-2.31)
(du Prel et al. 2006)	22,666 children age 6 in East Germany	sneeze attacks in the last 12 months"	Damp housing conditions	1.52 (1.26-1.83)
	6,222 children age 6 in West Germany	sneeze attacks in the last 12 months"	Damp housing conditions	2.25 (1.52-3.33)
(Hagerhed-Engman et al. 2009)	198 cases and 202 controls chosen through 2 qxs from children age 3-8 in Sweden	dr-dx rhinitis	severe moldy odor in home and/or at least 1 room, from inspection	1.07 (0.46 to 2.46)
			severe moldy odor along the skirting board in at least 1 room, from inspection	2.45 (1.08 to 5.54)
			severe visible spots of mold, stain of dampness or discolored stains on walls & ceiling in at least 1 room, from inspection	0.37 (0.04 to 3.43)
(Pirastu et al. 2009)	3,455 children age 5-12 in villages southwest of Italy	current rhino-conjunctivitis, from qx	observable mold, dampness, or fungi on the walls or ceiling of the child's bedroom in 1st year of the child's life (early), from qx	1.09 (0.68 to 1.76)
			observable mold, dampness, or fungi on the walls or ceiling of the child's	1.61 (1.04 to 2.49)

Table A2.15 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			bedroom recently (current), from qx	
			observable mold, dampness, or fungi on the walls or ceiling of the child's bedroom in the frst year of the child's life and recently (both), from qx	2.08 (1.32 to 3.28)
(Tham et al. 2007)	4,759 children age 1.5-6 in 120 day-care centers in Singapore	rhinitis in the past 12 mo, from qx	visible damp stains on the floor, walls, or ceilings in the room the child sleeps, from qx	1.27 (0.98 to 1.65)
		rhinoconjunctivitis in the past 12 mo, from qx		1.53 (1.00 to 2.33)*
		rhinitis in the past 12 mo, from qx	visible mold on the floor, walls, or ceilings in the room the child sleeps, from qx	1.55 (1.16 to 2.07)*
		rhinoconjunctivitis in the past 12 mo, from qx		2.38 (1.51 to 3.75)*
(Waegemaekers et al. 1989)	190 children	runny nose	parental-reported damp homes	5.92 (p-value<0.01)
Infants, Children, and Adults				
Intervention studies				
(Burr et al. 2007)	182 current asthmatics age 3-61 with indoor mold in South Wales	perceived rhinitis -- estimated difference in proportion improving, intervention vs. controls	controlled intervention -- visible mold removal plus fungicide and installation of ventilation fan	0-6 mo: 7% (-11 to 26); 0-12 mo: 24% (9 to 39)
		perceived rhinoconjunctivitis		06 mo: 16% (-3 to 35; 0-12 mo: 20% (5 to 36)
		perceived rhinitis affecting activities		0-6 mo: -1% (-23 to 22); 0-12 mo: 13% (-7 to 33)

[a] 10% difference in excess risk
[b] Dose response

Table A2.15 (cont.)

[c] No interaction models
[d] Interaction models

A2.16. Other respiratory effects

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Adults				
Prospective studies				
(Matheson et al. 2005)	845 adults aged between 20 and 45 years from the southeastern suburbs of Melbourne	bronchial hyper-responsiveness	Ergosterol in floor dust[a]	0.90 (0.59-1.36)
			Total fungi, culturable airborne[a]	0.99 (0.77-1.27)
			Cladosporium, culturable airborne[a]	1.0 (0.85-1.17)
			Other fungi, culturable airborne[a]	0.91 (0.77-1.06)
Cross-sectional studies				
(Park et al. 2006)	888 occupants of a water-damaged building	cough with phlegm	Fungi [b]	1.4 (0.82-2.30)
		cough with phlegm	Fungi (high), Endotoxin (low) [c]	1.2 (0.46-3.16)
		cough with phlegm	Fungi (low), Endotoxin (high) [c]	1.9 (0.73-5.00)
		cough with phlegm	Fungi (high), Endotoxin (high) [c]	2.7 (1.20-6.27)
(Lee et al. 2006)	24,784 participants between 26 and 50 years old in Taiwan	new-onset asthma sxs (wheeze, dyspnea, night cough) in prior 5 yrs	Water damage, current	0.81 (0.50-1.25)
			Visible mold, current	1.48 (1.07-2.01)
(Park et al. 2008)	200 adults in 3 respiratory case groups and 142 asymptomatic employees in a water-damaged office building in northeastern US	respiratory cases*	total culturable fungi in floor dust in total fungi models	1.46 (1.02 to 2.10) **
			total culturable fungi in chair dust in total fungi models	1.36 (0.99 to 1.87) *
			ergosterol in floor dust in total fungi models	1.40 (0.97 to 2.04) *
			ergosterol in chair dust in total fungi models	1.33 (0.93 to 1.91)
			endotoxin in floor dust in total fungi models	1.20 (0.75 to 1.90)

Table A2.16 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
			endotoxin in chair dust in total fungi model	0.91 (0.65 to 1.27)
			hydrophilic fungi in floor dust in hydrophilic fungi models	1.54 (1.05 to 2.27) **
			hydrophilic fungi in chair dust in hydrophilic fungi models	1.42 (1.03 to 1.95) **
			ergosterol in floor dust in hydrophilic fungi models	1.41 (0.97 to 2.05) *
			ergosterol in chair dust in hydrophilic fungi models	1.32 (0.92 to 1.89)
			endotoxin in floor dust in hydrophilic fungi models	1.21 (0.76 to 1.92)
			endotoxin in chair dust in hydrophilic fungi models	0.93 (0.67 to 1.28)
(Bjornsson et al. 1995)	88 individuals age 20-45 yo in a central Swedish municipality	asthma-related sx in the last 12 mo	total airborne bacteria (by staining on filter)	5.1 (1.3 to 20)*, OR per10-fold increase in bacteria
			total airborne molds (by staining on filter)	0.8 (0.1 to 5.1)
(Cox-Ganser et al. 2009)	1,171 workers in sentinel cases hospital or nearby control hospital in western U.S.	Work-related chest symptoms, last 12 mo	Dampness score from researcher observation, range 0-20: 0-2 3-5 6-20	Positive dose response: 1.0 approx 1.6 approx 2.4 (p<0.5)
		Work-related asthma symptoms, last 4 wks		Positive dose response: 1.0 approx 1.2 approx 2.2
		Work-related lower respiratory symptoms, last 12 mo last 4 wks	Airborne –culturable fungi, culturable bacteria, fungal spores, and endotoxin	All exposures positively associated with symptoms at both time periods 2.1 (1.3-3.5) for

Table A2.16 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
				top vs. bottom quartile of endotoxin
		Work-related lower respiratory symptoms –	Floor dust – culturable fungi,	
		last 12 mo		1.24 (0.88-1.75)
		last 4 wks		1.22 (0.75-1.98(
			Floor dust – (1-3)-ß-D-glucan	1.17 (0.79-1.73)
				1.46 (0.89-2.39)
			Floor dust – ergosterol	1.65 (1.16 -2.37) (dose-response)
				2.08 (1.31-3.32)
			Floor dust – EPS *Pen/Asp*	1.53 (0.99-2.38)
				1.90 (1.05-3.44)
			Floor dust – culturable bacteria	0.92 (0.56-1..51)
				1.36 (0.70-2.61)
			Floor dust – endotoxin	0.95 (0.73-1.24)
				1.12 (0.82-1.52).
		Work-related lower respiratory symptoms –	Chair dust – culturable fungi	
		last 12 mo		0.89 (0.61-1.29)
		last 4 wks		0.59 (0.35-1.02)
			Chair dust – (1-3)-ß-D-glucan	1.37 (0.90-2.09)
				1.03 (0.58-1.81)
			Chair dust – ergosterol	1.08 (0.72-1.62)
				0.92 (0.54-1.66)
			Chair dust – EPS *Pen/Asp*	1.06 (0.82-1.37)
				0.80 (0.55-1.15)
			Chair dust – culturable bacteria	1.17 (0.76-1.83)
				1.16 (0.65-2.08)
			Chair dust – endotoxin	1.25 (0.93-1.68)
				1.02 (0.70-1.48)

Table A2.16 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
Infants or Children				
Prospective studies				
(Dales et al. 2006)	332 children in Canada, followed from birth to age 2 yrs	no. of acute illness episodes /yr over 2 yrs (each 2+ days with at least 1 of stuffy nose, cough, wheeze, or SOB)	5-day average airborne endotoxin concentration in child's bedroom, measured in first 4 mo (80%) or first yr (20%) of life	coefficient for ln endotoxin from linear regression – ß (se) =0.46 (0.13), p=0.0003
		total no. of acute illness days during episodes/yr		ß (se) =4.68 (1.66), p=0.005
(Andriessen et al. 1998)	1614 children who were positive to symptoms of asthma and chronic cough	prevalence of lower respiratory symptoms	Moisture stains	1.04 (0.88-1.24)[e]
			Molds	1.03 (0.84-1.26)[e]
		prevalence of phlegm	Moisture stains	1.05 (0.89-1.23)[e]
			Molds	1.06 (0.88-1.27)[e]
Cross-sectional studies				
(Karevold et al. 2006)	3406 children (aged 10 years) living in Oslo, Norway	tonsillopharyngitis	Home dampness	1.4 (1.1-1.6)
(Dales et al. 1991)	14799 parents of school-aged children (aged between 5 and 8) in six regions of Canada	"lower respiratory symptoms"	Dampness/mold	1.62 (1.48-1.78)
		"chronic respiratory disease"		1.45 (1.29-1.64)
(Dong et al. 2008a)	10,784 children age 6-13 from urban areas in northeast China	persistent phlegm on 4 or more days per week in the past 12 mo	mold in the past 12 mo (signs of flooding, water damage or mold growth in the home)	1.59 (1.21 to 2.10)
(Dong et al. 2008b)	3,945 children aged 1-6 years from kindergartens in northeast China	persistent phlegm, last 12 mo	mold in past 12 mo (signs of flooding, water damage, or mold growth in home; from parental qx)	1.22 (0.81-1.84)
(Hagerhed-Engman et al.	198 cases and 202 controls chosen through 2 qxs	case status (2+ of	severe moldy odor in home and/or at	0.83 (0.44 to 1.56)

Table A2.16 (cont.)

Reference	Subjects	Outcome	Dampness or Mold Measure	Risk Estimate
2009)	from children age 3-8 in Sweden	wheeze, rhinitis, eczema)	least 1 room, from inspection	
			severe moldy odor along the skirting board in at least 1 room, from inspection	1.69 (0.88 to 3.26)
			severe visible spots of mold, stain of dampness or discolored stains on walls & ceiling in at least 1 room, from inspection	0.45 (0.13 to 1.55)

[a] Effect of doubling exposure to allergens or fungi on the remission of clinical outcomes:
[b] No interaction models
[c] Interaction models
[d] Incidence (mean ± SD)
[e] Adjusted prevalence rate ratios
* Respiratory cases (occupied the building at least 1 yr and report either: a) a current asthma with post-occupancy dr dx, b) 3 or more asthma-like sxs including wheezing, chest tightness, shortness of breath, coughing, and awakened by breathing difficulty, c) 2 or more hypersensitivity pneumonitis-like sxs including shortness of breath when walking up a hill, fever and chills, or flu-like achiness or achy joints over the past 4 wks)

3. Quantitative measurements of microbial organisms, components, or products included in reviewed studies

Table A3.1. Quantitative microbial measurements with suggestive associations for specific outcomes, or with inadequate evidence

Measurements with suggestive associations with specific health outcomes	ergosterol in dust, higher concentrations endotoxin in dust, higher concentrations (1-3)-ß-D-glucan in dust, *medium* concentrations (1-3)-ß-D-glucan in dust, *highest* concentrations	increased current asthma. increased wheeze. *increased* wheeze, *decreased* wheeze.
Microbial measurements with inadequate or insufficent evidence to determine whether an association exists with specific health outcomes	culturable fungi in air (total, *Cladosporium*, non-*Cladosporium*, total other than *Cladosporium*/*Penicillium*/yeast, *Penicillium*, *Alternaria*, Aspergillus, yeasts, from MEA medium, from DG18 medium); culturable airborne fungi, personal (total, from MEA medium, from DG18 medium); cultuable fungi in dust (total, *Alternaria*, *Aspergillus*, *Cladosporium*, *Aureobasidium*, yeasts, hydrophilic, mesophilic, zerophilic); total stained airborne fungi; ergosterol in air; (1-3)-ß-D-glucan in air; EPS *Penicillium*/*Aspergillus* in dust; total culturable bacteria in air; culturable airborne bacteria, personal; total stained airborne bacteria; total stained airborne bacteria, personal; mesophilic bacteria in dust; mesophilic actinomycetes in dust; muramic acid in dust; airborne endotoxin; 3-OHFA (C-10, C-12, C-14, C-16, and C-18).	

4. Additional details for Discussion section

Text A4.1 Dampness, mold, and hypersensitivity pneumonitis

Another type of health effect has not been covered in this epidemiologic review: some microbial exposures, based on substantial clinical evidence, have long been known to cause hypersensitivity pneumonitis (HP, or allergic alveolitis), a granulomatous lung disease involving cell-mediated immunity to antigens (Girard et al. 2009). This difficult-to-diagnose disease, originally recognized in adults with high antigen exposures in agricultural and industrial settings, has been repeatedly identified in damp buildings. Earlier outbreak investigations and case reports of HP in damp nonindustrial indoor environments have been summarized by Kreiss and Hodgson (1984). Multiple publications have reported on epidemiologic investigations of the co-occurrence of HP and building-related asthma in damp buildings (Cox-Ganser et al. 2005; Park et al. 2004). HP has also been documented to occur, often unrecognized, in children with antigen exposures in the home (Venkatesh and Wild 2005). This includes "summer-type hypersensitivity pneumonitis," with causation by a specific seasonal mold exposure (*Trichosporon cutaneum*) in Japanese homes documented clinically and epidemiologically (Ando et al. 1995). A recent case study documents HP caused by fungi in a U.S. home (Apostolakos et al. 2001). Thus, dampness-related microbiologic antigens in indoor settings, whether residential or occupational, clearly can cause HP, through similar immunologic sensitization as occurs in agricultural and industrial settings. Another granulomatous disease, incidence of which has been identified in damp buildings with HP and asthma, is sarcoidosis (Laney et al. 2009), which has also been linked to dampness or mold in other studies (Kucera et al. 2003; Newman et al. 2004).

Potentially related to HP is the set of epidemiologic findings, reviewed by Seppanen (2002), consistently associating increases in respiratory and other allergy-like symptoms with the presence of air-conditioning systems in office buildings. In these systems, air supplied to occupants for breathing passes over constantly moist cooling coils, providing long-term opportunities for microbial growth. A blinded, controlled, multiple crossover intervention study in four office buildings without evident HVAC contamination or occupant health complaints (Menzies et al. 2003) demonstrated another potential connection -- ultraviolet germicidal irradiation (UVGI) of wet surfaces in HVAC systems substantially reduced lower respiratory, mucosal, and musculoskeletal symptoms among occupants. This *prevention* of health effects occurred more strongly in non-smoking subjects (known to be more susceptible to HP) and included substantial reduction of muscle pains (a symptom found in HP): e.g., ORs (95% CIs) for lower respiratory symptoms with UVGI were, among current and never smokers, 0.7 (0.3-1.5) and 0.4 (0.4-0.9), respectively. This parallel to the symptoms and epidemiology of hypersensitivity pneumonitis suggests the possibility that biologic response to some microbial exposures from normal, not evidently contaminated, HVAC-systems may be mechanistically related to the immunologic response in HP.

Text A4.2. Fungal polymerase chain reaction assays in published studies assessing dampness, mold, and health

One promising approach for standardized assessment of indoor fungi, for either research or building assessment, is polymerase chain reaction (PCR) assays for specific fungal species. This approach was not reflected in the current review because the related epidemiologic field studies did not meet eligibility criteria. The most systematically used fungal PCR tool in published health studies has been a set of assays developed by the U.S. EPA to identify specific fungi in indoor dust – Mold-Specific Quantitative PCR (MSQPCR). Studies using MSQPCR assays have found different specific fungi associated with water damage or with health outcomes in different populations of buildings, suggesting that interpretion may be challenging. One widely available method using 36 MSQPCR assays for "diagnosis" of moisture problems, the Environmental Relative Moldiness Index (ERMI), had an unadjusted OR of 1.46 ($p=0.003$) for association with homes of asthmatics (Vesper et al. 2007). Comparing the mean ERMI among homes of non-asthmatics, moderate asthmatics, and severe asthmatics, unadjusted RRs that we estimated from reported means in Vesper et al. (2008) were 1.0, 1.02, and 1.32 respectively. (The one very high OR reported by a study using MSQPCR was based on an apparently invalid comparison (Vesper et al. 2006).) Despite the appeal of a standardized analysis method and interpretation strategy, however, none of these findings have been separately replicated, the published studies do not provide a consistent rationale for defining the fungal subgroups used to construct the ERMI scale, and current evidence (e.g., comparing the reported strength of association with health effects of ERMI/MSQPCR vs. evident dampness or mold) does not yet favor these assays. Improved interpretations of fungal PCR based on careful epidemiologic studies may provide more effective interpretation strategies.

References (for Supplemental Materials)

Alper Z, Sapan N, Ercan I, Canitez Y, Bilgel N. 2006. Risk factors for wheezing in primary school children in Bursa, Turkey. Am J Rhinol 20(1):53-63.

Ando M, Suga M, Nishiura Y, Miyajima M. 1995. Summer-type hypersensitivity pneumonitis. Intern Med 34(8):707-12.

Andriessen JW, Brunekreef B, Roemer W. 1998. Home dampness and respiratory health status in European children. Clin Exp Allergy 28(10):1191-200.

Apostolakos MJ, Rossmoore H, Beckett WS. 2001. Hypersensitivity pneumonitis from ordinary residential exposures. Environ Health Perspect 109(9):979-81.

Austin JB, Russell G. 1997. Wheeze, cough, atopy, and indoor environment in the Scottish highlands. Arch Dis Child 76(1):22-6.

Bakke JV, Norback D, Wieslander G, Hollund BE, Moen BE. 2007. Pet keeping and dampness in the dwelling: Associations with airway infections, symptoms, and physiological signs from the ocular and nasal mucosa. Indoor Air 17(1):60-69; doi: doi:10.1111/j.1600-0668.2006.00455.x.

Belanger K, Beckett W, Triche E, Bracken MB, Holford T, Ren P et al. 2003. Symptoms of wheeze and persistent cough in the first year of life: Associations with indoor allergens, air contaminants, and maternal history of asthma. Am J Epidemiol 158(3):195-202.

Bernstein JA, Bobbitt RC, Levin L, Floyd R, Crandall MS, Shalwitz RA et al. 2006. Health effects of ultraviolet irradiation in asthmatic children's homes. J Asthma 43(4):255-62.

Biagini JM, LeMasters GK, Ryan PH, Levin L, Reponen T, Bernstein DI et al. 2006. Environmental risk factors of rhinitis in early infancy. Pediatr Allergy Immunol 17(4):278-84.

Bjornsson E, Norback D, Janson C, Widstrom J, Palmgren U, Strom G et al. 1995. Asthmatic symptoms and indoor levels of micro-organisms and house dust mites. Clin Exp Allergy 25(5):423-31.

Bolte G, Bischof W, Borte M, Lehmann I, Wichmann HE, Heinrich J. 2003. Early endotoxin exposure and atopy development in infants: Results of a birth cohort study. Clin Exp Allergy 33(6):770-6.

Bonner S, Matte TD, Fagan J, Andreopoulos E, Evans D. 2006. Self-reported moisture or mildew in the homes of head start children with asthma is associated with greater asthma morbidity. J Urban Health 83(1):129-37.

Bornehag CG, Sundell J, Hagerhed-Engman L, Sigsggard T, Janson S, Aberg N. 2005. 'Dampness' at home and its association with airway, nose, and skin symptoms among 10,851 preschool children in Sweden: A cross-sectional study. Indoor Air 15 Suppl 10:48-55.

Brunekreef B. 1992a. Associations between questionnaire reports of home dampness and childhood respiratory symptoms. Sci Total Environ 127(1-2):79-89.

Brunekreef B. 1992b. Damp housing and adult respiratory symptoms. Allergy 47(5):498-502.

Brunekreef B, Dockery DW, Speizer FE, Ware JH, Spengler JD, Ferris BG. 1989. Home dampness and respiratory morbidity in children. Am Rev Respir Dis 140(5):1363-7.

Burr ML, Matthews IP, Arthur RA, Watson HL, Gregory CJ, Dunstan FD et al. 2007. Effects on patients with asthma of eradicating visible indoor mould: A randomised controlled trial. Thorax 62(9):767-772; doi: 10.1136/thx.2006.070847.

Campo P, Kalra HK, Levin L, Reponen T, Olds R, Lummus ZL et al. 2006. Influence of dog ownership and high endotoxin on wheezing and atopy during infancy. J Allergy Clin Immunol 118(6):1271-8.
Cho SH, Reponen T, LeMasters G, Levin L, Huang J, Meklin T et al. 2006. Mold damage in homes and wheezing in infants. Ann Allergy Asthma Immunol 97(4):539-45.
Chong Neto HJ, Rosario NA, Grupo EISL Curitiba (Estudio Internacional de Sibilancias en Lactantes). 2008. Risk factors for wheezing in the first year of life. J Pediatr (Rio J) 84(6):495-502; doi: doi:10.2223/JPED.1835.
Cox-Ganser JM, Rao CY, Park JH, Schumpert JC, Kreiss K. 2009. Asthma and respiratory symptoms in hospital workers related to dampness and biological contaminants. Indoor Air 19(4):280-290; doi: 10.1111/j.1600-0668.2009.00586.x.
Cox-Ganser JM, White SK, Jones R, Hilsbos K, Storey E, Enright PL et al. 2005. Respiratory morbidity in office workers in a water-damaged building. Environ Health Perspect 113(4):485-90.
Cuijpers CE, Swaen GM, Wesseling G, Sturmans F, Wouters EF. 1995. Adverse effects of the indoor environment on respiratory health in primary school children. Environ Res 68(1):11-23.
Dales R, Miller D, Ruest K, Guay M, Judek S. 2006. Airborne endotoxin is associated with respiratory illness in the first 2 years of life. Environ Health Perspect 114(4):610-4.
Dales RE, Burnett R, Zwanenburg H. 1991. Adverse health effects among adults exposed to home dampness and molds. Am Rev Respir Dis 143(3):505-9.
Dales RE, Miller D. 1999. Residential fungal contamination and health: Microbial cohabitants as covariates. Environ Health Perspect 107 Suppl 3:481-3.
Dales RE, Zwanenburg H, Burnett R, Franklin CA. 1991. Respiratory health effects of home dampness and molds among Canadian children. Am J Epidemiol 134(2):196-203.
Dekker C, Dales R, Bartlett S, Brunekreef B, Zwanenburg H. 1991. Childhood asthma and the indoor environment. Chest 100(4):922-6.
Dharmage S, Bailey M, Raven J, Abeyawickrama K, Cao D, Guest D et al. 2002. Mouldy houses influence symptoms of asthma among atopic individuals. Clin Exp Allergy 32(5):714-20.
Dharmage S, Bailey M, Raven J, Mitakakis T, Cheng A, Guest D et al. 2001. Current indoor allergen levels of fungi and cats, but not house dust mites, influence allergy and asthma in adults with high dust mite exposure. Am J Respir Crit Care Med 164(1):65-71.
Diez U, Rehwagen M, Rolle-Kampczyk U, Wetzig H, Schulz R, Richter M et al. 2003. Redecoration of apartments promotes obstructive bronchitis in atopy risk infants--results of the LARS study. Int J Hyg Environ Health 206(3):173-9.
Dijkstra L, Houthuijs D, Brunekreef B, Akkerman I, Boleij JS. 1990. Respiratory health effects of the indoor environment in a population of Dutch children. Am Rev Respir Dis 142(5):1172-8.
Dong GH, Ma YN, Ding HL, Jin J, Cao Y, Zhao YD et al. 2008a. Effects of housing characteristics and home environmental factors on respiratory symptoms of 10,784 elementary school children from northeast China. Respiration 76(1):82-91; doi: 10.1159/000121370.
Dong GH, Ma YN, Ding HL, Jin J, Cao Y, Zhao YD et al. 2008b. Housing characteristics, home environmental factors and respiratory health in 3945 pre-

school children in China. Int J Environ Health Res 18(4):267-282; doi: 10.1080/09603120701842864.
Douwes J, van Strien R, Doekes G, Smit J, Kerkhof M, Gerritsen J et al. 2006. Does early indoor microbial exposure reduce the risk of asthma? The Prevention and Incidence of Asthma and Mite Allergy Birth Cohort Study. J Allergy Clin Immunol 117(5):1067-73.
du Prel X, Kramer U, Behrendt H, Ring J, Oppermann H, Schikowski T et al. 2006. Preschool children's health and its association with parental education and individual living conditions in East and West Germany. BMC Public Health 6:312.
Ebbehoj NE, Meyer HW, Wurtz H, Suadicani P, Valbjorn O, Sigsgaard T et al. 2005. Molds in floor dust, building-related symptoms, and lung function among male and female schoolteachers. Indoor Air 15 Suppl 10:7-16.
Ekici M, Ekici A, Akin A, Altinkaya V, Bulcun E. 2008. Chronic airway diseases in adult life and childhood infections. Respiration 75(1):55-59.
El-Sharif N, Abdeen Z, Barghuthy F, Nemery B. 2003. Familial and environmental determinants for wheezing and asthma in a case-control study of school children in Palestine. Clin Exp Allergy 33(2):176-86.
Emenius G, Svartengren M, Korsgaard J, Nordvall L, Pershagen G, Wickman M. 2004a. Building characteristics, indoor air quality and recurrent wheezing in very young children (BAMSE). Indoor Air 14(1):34-42.
Emenius G, Svartengren M, Korsgaard J, Nordvall L, Pershagen G, Wickman M. 2004b. Indoor exposures and recurrent wheezing in infants: A study in the BAMSE cohort. Acta Paediatr 93(7):899-905.
Engvall K, Norrby C, Norback D. 2001. Asthma symptoms in relation to building dampness and odour in older multifamily houses in Stockholm. Int J Tuberc Lung Dis 5(5):468-77.
Engvall K, Norrby C, Norback D. 2002. Ocular, airway, and dermal symptoms related to building dampness and odors in dwellings. Arch Environ Health 57(4):304-10.
Forsberg B, Pekkanen J, Clench-Aas J, Martensson MB, Stjernberg N, Bartonova A et al. 1997. Childhood asthma in four regions in Scandinavia: Risk factors and avoidance effects. Int J Epidemiol 26(3):610-9.
Gehring U, Strikwold M, Schram-Bijkerk D, Weinmayr G, Genuneit J, Nagel G et al. 2008. Asthma and allergic symptoms in relation to house dust endotoxin: Phase two of the International Study on Asthma and Allergies in Childhood (ISAAC II). Clin Exp Allergy 38(12):1911-1920; doi: 10.1111/j.1365-2222.2008.03087.x.
Gent JF, Ren P, Belanger K, Triche E, Bracken MB, Holford TR et al. 2002. Levels of household mold associated with respiratory symptoms in the first year of life in a cohort at risk for asthma. Environ Health Perspect 110(12):A781-6.
Gillespie J, Wickens K, Siebers R, Howden-Chapman P, Town I, Epton M et al. 2006. Endotoxin exposure, wheezing, and rash in infancy in a New Zealand birth cohort. J Allergy Clin Immunol 118(6):1265-1270; doi: 10.1016/j.jaci.2006.07.051.
Girard M, Lacasse Y, Cormier Y. 2009. Hypersensitivity pneumonitis. Allergy 64(3):322-334; doi: 10.1111/j.1398-9995.2009.01949.x.
Gunnbjornsdottir MI, Franklin KA, Norback D, Bjornsson E, Gislason D, Lindberg E et al. 2006. Prevalence and incidence of respiratory symptoms in relationship to indoor dampness: The RHINE study. Thorax 61(13):221-225.
Gunnbjornsdottir MI, Norback D, Plaschke P, Norrman E, Bjornsson E, Janson C. 2003. The relationship between indicators of building dampness and respiratory health in young Swedish adults. Respir Med 97(4):302-7.

Hagerhed-Engman L, Sigsgaard T, Samuelson I, Sundell J, Janson S, Bornehag CG. 2009. Low home ventilation rate in combination with moldy odor from the building structure increase the risk for allergic symptoms in children. Indoor Air 19(3):184-192; doi: 10.1111/j.1600-0668.2008.00573.x.

Hagmolen of Ten Have W, van den Berg NJ, van der Palen J, van Aalderen WM, Bindels PJ. 2007. Residential exposure to mould and dampness is associated with adverse respiratory health. Clin Exp Allergy 37(12):1827-1832; doi: 10.1111/j.1365-2222.2007.02841.x.

Haverinen U, Husman T, Vahteristo M, Koskinen O, Moschandreas D, Nevalainen A et al. 2001. Comparison of two-level and three-level classifications of moisture-damaged dwellings in relation to health effects. Indoor Air 11(3):192-199.

Haverinen-Shaughnessy U, Toivola M, Alm S, Putus T, Nevalainen A. 2007. Personal and microenvironmental concentrations of particles and microbial aerosol in relation to health symptoms among teachers. J Expo Sci Environ Epidemiol 17(2):182-90.

Hsu SP, Lin KN, Tan CT, Lee FP, Huang HM. 2009. Prenatal risk factors and occurrence of allergic rhinitis among elementary school children in an urban city. Int J Pediatr Otorhinolaryngol 73(6):807-810; doi: 10.1016/j.ijporl.2009.02.023.

Hu FB, Persky V, Flay BR, Richardson J. 1997. An epidemiological study of asthma prevalence and related factors among young adults. J Asthma 34(1):67-76.

Hyvarinen A, Sebastian A, Pekkanen J, Larsson L, Korppi M, Putus T et al. 2006. Characterizing microbial exposure with ergosterol, 3-hydroxy fatty acids, and viable microbes in house dust: Determinants and association with childhood asthma. Arch Environ Occup Health 61(4):149-157.

Infante-Rivard C. 1993. Childhood asthma and indoor environmental risk factors. Am J Epidemiol 137(8):834-44.

Institute of Medicine. 2004. Damp Indoor Spaces and Health. Washington, D.C.:National Academies Press.

Iossifova YY, Reponen T, Bernstein DI, Levin L, Kalra H, Campo P et al. 2007. House dust (1-3)-beta-d-glucan and wheezing in infants. Allergy 62(5):504-513; doi: doi:10.1111/j.1398-9995.2007.01340.x.

Iossifova YY, Reponen T, Ryan PH, Levin L, Bernstein DI, Lockey JE et al. 2009. Mold exposure during infancy as a predictor of potential asthma development. Ann Allergy Asthma Immunol 102(2):131-137.

Jaakkola JJ, Hwang BF, Jaakkola N. 2005. Home dampness and molds, parental atopy, and asthma in childhood: A six-year population-based cohort study. Environ Health Perspect 113(3):357-61.

Jaakkola JJ, Jaakkola N, Ruotsalainen R. 1993. Home dampness and molds as determinants of respiratory symptoms and asthma in pre-school children. J Expo Anal Environ Epidemiol 3(Suppl 1):129-42.

Jaakkola MS, Nordman H, Piipari R, Uitti J, Laitinen J, Karjalainen A et al. 2002. Indoor dampness and molds and development of adult-onset asthma: A population-based incident case-control study. Environ Health Perspect 110(5):543-7.

Jedrychowski W, Flak E. 1998. Separate and combined effects of the outdoor and indoor air quality on chronic respiratory symptoms adjusted for allergy among preadolescent children. Int J Occup Med Environ Health 11(1):19-35.

Jeedrychowski W, Maugeri U, Zembala M, Perzanowski MS, Hajto B, Flak E et al. 2007. Risk of wheezing associated with house-dust mite allergens and indoor air

quality among three-year-old children. Krakow inner city study. Int J Occup Med Environ Health 20(2):117-126; doi: 10.2478/v10001-007-0013-5.
Jovanovic S, Felder-Kennel A, Gabrio T, Kouros B, Link B, Maisner V et al. 2004. Indoor fungi levels in homes of children with and without allergy history. Int J Hyg Environ Health 207(4):369-78.
Karevold G, Kvestad E, Nafstad P, Kvaerner KJ. 2006. Respiratory infections in schoolchildren: Co-morbidity and risk factors. Arch Dis Child 91(5):391-5.
Karvonen AM, Hyvarinen A, Roponen M, Hoffmann M, Korppi M, Remes S et al. 2009. Confirmed moisture damage at home, respiratory symptoms and atopy in early life: A birth-cohort study. Pediatrics 124(2):e329-38; doi: 10.1542/peds.2008-1590.
Kercsmar CM, Dearborn DG, Schluchter M, Xue L, Kirchner HL, Sobolewski J et al. 2006. Reduction in asthma morbidity in children as a result of home remediation aimed at moisture sources. Environ Health Perspect 114(10):1574-80.
Kilpelainen M, Terho EO, Helenius H, Koskenvuo M. 2001. Home dampness, current allergic diseases, and respiratory infections among young adults. Thorax 56(6):462-7.
Koskinen OM, Husman TM, Meklin TM, Nevalainen AI. 1999a. Adverse health effects in children associated with moisture and mold observations in houses. International Journal of Environmental Health Research 9(2):143-156.
Koskinen OM, Husman TM, Meklin TM, Nevalainen AI. 1999b. The relationship between moisture or mould observations in houses and the state of health of their occupants. Eur Respir J 14(6):1363-7.
Kreiss K, Hodgson MJ. 1984. Building associated epidemics. In: Indoor Air Quality (Walsh PJ, Dudney CS, Copenhaver ED, eds) . Boca Raton, FL:CRC Press, 87-108.
Kucera GP, Rybicki BA, Kirkey KL, Coon SW, Major ML, Maliarik MJ et al. 2003. Occupational risk factors for sarcoidosis in African-American siblings. Chest 123(5):1527-35.
Kuyucu S, Saraclar Y, Tuncer A, Geyik PO, Adalioglu G, Akpinarli A et al. 2006. Epidemiologic characteristics of rhinitis in Turkish children: The International Study of Asthma and Allergies in Childhood (ISAAC) phase 2. Pediatr Allergy Immunol 17(4):269-77.
Laney AS, Cragin LA, Blevins LZ, Sumner AD, Cox-Ganser JM, Kreiss K et al. 2009. Sarcoidosis, asthma, and asthma-like symptoms among occupants of a historically water-damaged office building. Indoor Air 19(1):83-90; doi: 10.1111/j.1600-0668.2008.00564.x.
Lawson JA, Rennie DC, Senthilselvan A, Cockcroft DW, McDuffie HH. 2005. Regional variations in risk factors for asthma in school children. Can Respir J 12(6):321-6.
Lee YL, Hsiue TR, Lee CH, Su HJ, Leon Guo Y. 2006. Home exposures, parental atopy, and occurrence of asthma symptoms in adulthood in southern Taiwan. Chest 129(2):300-8.
Lee YL, Lin YC, Hsiue TR, Hwang BF, Guo YL. 2003. Indoor and outdoor environmental exposures, parental atopy, and physician-diagnosed asthma in Taiwanese schoolchildren. Pediatrics 112(5):e389.
Li CS, Hsu LY. 1996. Home dampness and childhood respiratory symptoms in a subtropical climate. Arch Environ Health 51(1):42-6.

Li CS, Hsu LY. 1997. Airborne fungus allergen in association with residential characteristics in atopic and control children in a subtropical region. Arch Environ Health 52(1):72-9.
Litonjua AA, Milton DK, Celedon JC, Ryan L, Weiss ST, Gold DR. 2002. A longitudinal analysis of wheezing in young children: The independent effects of early life exposure to house dust endotoxin, allergens, and pets. J Allergy Clin Immunol 110(5):736-742.
Maier WC, Arrighi HM, Morray B, Llewellyn C, Redding GJ. 1997. Indoor risk factors for asthma and wheezing among Seattle school children. Environ Health Perspect 105(2):208-14.
Matheson MC, Abramson MJ, Dharmage SC, Forbes AB, Raven JM, Thien FC et al. 2005. Changes in indoor allergen and fungal levels predict changes in asthma activity among young adults. Clin Exp Allergy 35(7):907-13.
Menzies D, Popa J, Hanley JA, Rand T, Milton DK. 2003. Effect of ultraviolet germicidal lights installed in office ventilation systems on workers' health and wellbeing: Double-blind multiple crossover trial. Lancet 362(9398):1785-91.
Miyake Y, Ohya Y, Tanaka K, Yokoyama T, Sasaki S, Fukushima W et al. 2007. Home environment and suspected atopic eczema in Japanese infants: The Osaka maternal and child health study. Pediatr Allergy Immunol 18(5):425-432; doi: 10.1111/j.1399-3038.2007.00545.x.
Mohamed N, Ng'ang'a L, Odhiambo J, Nyamwaya J, Menzies R. 1995. Home environment and asthma in Kenyan schoolchildren: A case-control study. Thorax 50(1):74-8.
Mommers M, Jongmans-Liedekerken AW, Derkx R, Dott W, Mertens P, van Schayck CP et al. 2005. Indoor environment and respiratory symptoms in children living in the Dutch-German borderland. Int J Hyg Environ Health 208(5):373-81.
Muller A, Lehmann I, Seiffart A, Diez U, Wetzig H, Borte M et al. 2002. Increased incidence of allergic sensitisation and respiratory diseases due to mould exposure: Results of the Leipzig Allergy Risk Children Study (LARS). Int J Hyg Environ Health 204(5-6):363-5.
Nafstad P, Jaakkola JJ, Skrondal A, Magnus P. 2005. Day care center characteristics and children's respiratory health. Indoor Air 15(2):69-75.
Nafstad P, Oie L, Mehl R, Gaarder PI, Lodrup-Carlsen KC, Botten G et al. 1998. Residential dampness problems and symptoms and signs of bronchial obstruction in young Norwegian children. Am J Respir Crit Care Med 157(2):410-4.
Newman LS, Rose CS, Bresnitz EA, Rossman MD, Barnard J, Frederick M et al. 2004. A case control etiologic study of sarcoidosis: Environmental and occupational risk factors. Am J Respir Crit Care Med 170(12):1324-30.
Nicolai T, Illi S, von Mutius E. 1998. Effect of dampness at home in childhood on bronchial hyperreactivity in adolescence. Thorax 53(12):1035-40.
Norbäck D, Bjornsson E, Janson C, Palmgren U, Boman G. 1999. Current asthma and biochemical signs of inflammation in relation to building dampness in dwellings. Int J Tuberc Lung Dis 3(5):368-76.
Nriagu J, Robins T, Gary L, Liggans G, Davila R, Supuwood K et al. 1999. Prevalence of asthma and respiratory symptoms in south-central Durban, South Africa. Eur J Epidemiol 15(8):747-55.
Oie L, Nafstad P, Botten G, Magnus P, Jaakkola JK. 1999. Ventilation in homes and bronchial obstruction in young children. Epidemiology 10(3):294-9.

Park JH, Cox-Ganser J, Rao C, Kreiss K. 2006. Fungal and endotoxin measurements in dust associated with respiratory symptoms in a water-damaged office building. Indoor Air 16(3):192-203.
Park JH, Cox-Ganser JM, Kreiss K, White SK, Rao CY. 2008. Hydrophilic fungi and ergosterol associated with respiratory illness in a water-damaged building. Environ Health Perspect 116(1):45-50.
Park JH, Gold DR, Spiegelman DL, Burge HA, Milton DK. 2001. House dust endotoxin and wheeze in the first year of life. Am J Respir Crit Care Med 163(2):322-8.
Park JH, Schleiff PL, Attfield MD, Cox-Ganser JM, Kreiss K. 2004. Building-related respiratory symptoms can be predicted with semi-quantitative indices of exposure to dampness and mold. Indoor Air 14(6):425-33.
Pekkanen J, Hyvarinen A, Haverinen-Shaughnessy U, Korppi M, Putus T, Nevalainen A. 2007. Moisture damage and childhood asthma: A population-based incident case-control study. Eur Respir J 29(3):509-15.
Perzanowski MS, Miller RL, Thorne PS, Barr RG, Divjan A, Sheares BJ et al. 2006. Endotoxin in inner-city homes: Associations with wheeze and eczema in early childhood. J Allergy Clin Immunol 117(5):1082-1089; doi: 10.1016/j.jaci.2005.12.1348.
Peters JM, Avol E, Navidi W, London SJ, Gauderman WJ, Lurmann F et al. 1999. A study of twelve southern California communities with differing levels and types of air pollution. I. prevalence of respiratory morbidity. Am J Respir Crit Care Med 159(3):760-7.
Pettigrew MM, Gent JF, Triche EW, Belanger KD, Bracken MB, Leaderer BP. 2004. Association of early-onset otitis media in infants and exposure to household mould. Paediatr Perinat Epidemiol 18(6):441-7.
Pirastu R, Bellu C, Greco P, Pelosi U, Pistelli R, Accetta G et al. 2009. Indoor exposure to environmental tobacco smoke and dampness: Respiratory symptoms in Sardinian children--DRIAS study. Environ Res 109(1):59-65; doi: 10.1016/j.envres.2008.09.002.
Pirhonen I, Nevalainen A, Husman T, Pekkanen J. 1996. Home dampness, moulds and their influence on respiratory infections and symptoms in adults in Finland. Eur Respir J 9(12):2618-22.
Ponsonby AL, Couper D, Dwyer T, Carmichael A, Kemp A, Cochrane J. 2000. The relation between infant indoor environment and subsequent asthma. Epidemiology 11(2):128-35.
Potts JF, Rona RJ, Oyarzun MJ, Amigo H, Bustos P. 2008. Indoor risk factors for cough and their relation to wheeze and sensitization in Chilean young adults. Am J Public Health 98(4):680-686; doi: 10.2105/AJPH.2006.093302.
Rennie D, Chen Y, Lawson J, Dosman J. 2005. Differential effect of damp housing on respiratory health in women. J Am Med Womens Assoc 60(1):46-51.
Ronmark E, Jonsson E, Platts-Mills T, Lundback B. 1999. Different pattern of risk factors for atopic and nonatopic asthma among children--report from the obstructive lung disease in northern Sweden study. Allergy 54(9):926-35.
Ronmark E, Perzanowski M, Platts-Mills T, Lundback B. 2002. Incidence rates and risk factors for asthma among school children: A 2-year follow-up report from the obstructive lung disease in northern Sweden (OLIN) studies. Respir Med 96(12):1006-13.

Ruotsalainen R, Jaakkola N, Jaakkola JJ. 1995. Dampness and molds in day-care centers as an occupational health problem. Int Arch Occup Environ Health 66(6):369-74.
Rylander R, Megevand Y. 2000. Environmental risk factors for respiratory infections. Arch Environ Health 55(5):300-3.
Rylander R, Norrhall M, Engdahl U, Tunsater A, Holt PG. 1998. Airways inflammation, atopy, and (1--> 3)-beta-D-glucan exposures in two schools. Am J Respir Crit Care Med 158(5 Pt 1):1685-7.
Salo PM, J. AS,Jr, Sever M, Jaramillo R, Cohn RD, London SJ et al. 2006. Exposure to alternaria alternata in US homes is associated with asthma symptoms. J Allergy Clin Immunol 118(4):892-8.
Schafer T, Kramer U, Dockery D, Vieluf D, Behrendt H, Ring J. 1999. What makes a child allergic? Analysis of risk factors for allergic sensitization in preschool children from east and west germany. Allergy Asthma Proc 20(1):23-7.
Schram-Bijkerk D, Doekes G, Douwes J, Boeve M, Riedler J, Ublagger E et al. 2005. Bacterial and fungal agents in house dust and wheeze in children: The PARSIFAL study. Clin Exp Allergy 35(10):1272-8.
Seppanen O, Fisk WJ. 2002. Association of ventilation system type with SBS symptoms in office workers. Indoor Air 12(2):98-112.
Simoni M, Lombardi E, Berti G, Rusconi F, La Grutta S, Piffer S et al. 2005. Mould/dampness exposure at home is associated with respiratory disorders in italian children and adolescents: The SIDRIA-2 study. Occup Environ Med 62(9):616-22.
Skorge TD, Eagan TM, Eide GE, Gulsvik A, Bakke PS. 2005. Indoor exposures and respiratory symptoms in a Norwegian community sample. Thorax 60(11):937-42.
Slezak JA, Persky VW, Kviz FJ, Ramakrishnan V, Byers C. 1998. Asthma prevalence and risk factors in selected head start sites in Chicago. J Asthma 35(2):203-12.
Sotir M, Yeatts K, Shy C. 2003. Presence of asthma risk factors and environmental exposures related to upper respiratory infection-triggered wheezing in middle school-age children. Environ Health Perspect 111(4):657-62.
Spengler JD, Jaakkola JJ, Parise H, Katsnelson BA, Privalova LI, Kosheleva AA. 2004. Housing characteristics and children's respiratory health in the Russian Federation. Am J Public Health 94(4):657-62.
Stark PC, Burge HA, Ryan LM, Milton DK, Gold DR. 2003. Fungal levels in the home and lower respiratory tract illnesses in the first year of life. Am J Respir Crit Care Med 168(2):232-7.
Stark PC, Celedon JC, Chew GL, Ryan LM, Burge HA, Muilenberg ML et al. 2005. Fungal levels in the home and allergic rhinitis by 5 years of age. Environ Health Perspect 113(10):1405-9.
Strachan DP, Carey IM. 1995. Home environment and severe asthma in adolescence: A population based case-control study. BMJ 311(7012):1053-6.
Strachan DP, Elton RA. 1986. Relationship between respiratory morbidity in children and the home environment. Fam Pract 3(3):137-42.
Strachan DP, Flannigan B, McCabe EM, McGarry F. 1990. Quantification of airborne moulds in the homes of children with and without wheeze. Thorax 45(5):382-7.
Sun Y, Zhang Y, Sundell J, Fan Z, Bao L. 2009. Dampness at dorm and its associations with allergy and airways infection among college students in China: A cross-sectional study. Indoor Air 19(2):174-182; doi: 10.1111/j.1600-0668.2008.00577.x.

Taskinen T, Hyvarinen A, Meklin T, Husman T, Nevalainen A, Korppi M. 1999. Asthma and respiratory infections in school children with special reference to moisture and mold problems in the school. Acta Paediatr 88(12):1373-9.
Tavernier G, Fletcher G, Gee I, Watson A, Blacklock G, Francis H et al. 2006. IPEADAM study: Indoor endotoxin exposure, family status, and some housing characteristics in English children. J Allergy Clin Immunol 117(3):656-62.
Tham KW, Zuraimi MS, Koh D, Chew FT, Ooi PL. 2007. Associations between home dampness and presence of molds with asthma and allergic symptoms among young children in the tropics. Pediatr Allergy Immunol 18(5):418-424; doi: 10.1111/j.1399-3038.2007.00544.x.
Thorn J, Brisman J, Toren K. 2001. Adult-onset asthma is associated with self-reported mold or environmental tobacco smoke exposures in the home. Allergy 56(4):287-92.
Thorn J, Rylander R. 1998. Airways inflammation and glucan in a rowhouse area. Am J Respir Crit Care Med 157(6 Pt 1):1798-803.
Tsai HJ, Tsai AC, Nriagu J, Ghosh D, Gong M, Sandretto A. 2006. Risk factors for respiratory symptoms and asthma in the residential environment of 5th grade schoolchildren in Taipei, Taiwan. J Asthma 43(5):355-61.
Turyk M, Curtis L, Scheff P, Contraras A, Coover L, Hernandez E et al. 2006. Environmental allergens and asthma morbidity in low-income children. J Asthma 43(6):453-7.
van Gageldonk-Lafeber AB, van der Sande MA, Heijnen ML, Peeters MF, Bartelds AI, Wilbrink B. 2007. Risk factors for acute respiratory tract infections in general practitioner patients in the Netherlands: A case-control study. BMC Infect Dis 7:35.
Venkatesh P, Wild L. 2005. Hypersensitivity pneumonitis in children: Clinical features, diagnosis, and treatment. Paediatr Drugs 7(4):235-244.
Venn AJ, Cooper M, Antoniak M, Laughlin C, Britton J, Lewis SA. 2003. Effects of volatile organic compounds, damp, and other environmental exposures in the home on wheezing illness in children. Thorax 58(11):955-60.
Verhoeff AP, van Strien RT, van Wijnen JH, Brunekreef B. 1995. Damp housing and childhood respiratory symptoms: The role of sensitization to dust mites and molds. Am J Epidemiol 141(2):103-10.
Vesper S, McKinstry C, Ashley P, Haugland R, Yeatts K, Bradham K et al. 2007. Quantitative PCR analysis of molds in the dust from homes of asthmatic children in North Carolina. J Environ Monit 9(8):826-830; doi: 10.1039/b704359g.
Vesper S, McKinstry C, Haugland R, Neas L, Hudgens E, Heidenfelder B et al. 2008. Higher environmental relative moldiness index (ERMIsm) values measured in Detroit homes of severely asthmatic children. Sci Total Environ 394(1):192-196; doi: 10.1016/j.scitotenv.2008.01.031.
Vesper SJ, McKinstry C, Yang C, Haugland RA, Kercsmar CM, Yike I et al. 2006. Specific molds associated with asthma in water-damaged homes. J Occup Environ Med 48(8):852-8.
Waegemaekers M, Van Wageningen N, Brunekreef B, Boleij JS. 1989. Respiratory symptoms in damp homes. A pilot study. Allergy 44(3):192-8.
Wan GH, Li CS. 1999. Dampness and airway inflammation and systemic symptoms in office building workers. Arch Environ Health 54(1):58-63.
Wever-Hess J, Kouwenberg JM, Duiverman EJ, Hermans J, Wever AM. 2000. Risk factors for exacerbations and hospital admissions in asthma of early childhood. Pediatr Pulmonol 29(4):250-6.

Wickens K, Pearce N, Siebers R, Ellis I, Patchett K, Sawyer G et al. 1999. Indoor environment, atopy and the risk of the asthma in children in New Zealand. Pediatr Allergy Immunol 10(3):199-208.
Wieslander G, Norback D, Nordstrom K, Walinder R, Venge P. 1999. Nasal and ocular symptoms, tear film stability and biomarkers in nasal lavage, in relation to building-dampness and building design in hospitals. Int Arch Occup Environ Health 72(7):451-61.
Williamson IJ, Martin CJ, McGill G, Monie RD, Fennerty AG. 1997. Damp housing and asthma: A case-control study. Thorax 52(3):229-34.
Yang CY, Cheng MF, Tsai SS, Hung CF, Lai TC, Hwang KC. 1999. Effects of indoor environmental factors on risk for acute otitis media in a subtropical area. J Toxicol Environ Health A 56(2):111-119.
Yang CY, Chiu JF, Cheng MF, Lin MC. 1997a. Effects of indoor environmental factors on respiratory health of children in a subtropical climate. Environ Res 75(1):49-55.
Yang CY, Chiu JF, Chiu HF, Kao WY. 1997b. Damp housing conditions and respiratory symptoms in primary school children. Pediatr Pulmonol 24(2):73-7.
Yang CY, Lin MC, Hwang KC. 1998a. Childhood asthma and the indoor environment in a subtropical area. Chest 114(2):393-7.
Yang CY, Tien YC, Hsieh HJ, Kao WY, Lin MC. 1998b. Indoor environmental risk factors and childhood asthma: A case-control study in a subtropical area. Pediatr Pulmonol 26(2):120-4.
Yangzong, Nafstad P, Madsen C, Bjertness E. 2006. Childhood asthma under the north face of mount everest. J Asthma 43(5):393-8.
Yazicioglu M, Saltik A, Ones U, Sam A, Ekerbicer HC, Kircuval O. 1998. Home environment and asthma in school children from the Edirne region in Turkey. Allergol Immunopathol (Madr) 26(1):5-8.
Zacharasiewicz A, Zidek T, Haidinger G, Waldhor T, Vutuc C, Goetz M et al. 2000. Symptoms suggestive of atopic rhinitis in children aged 6-9 years and the indoor environment. Allergy 55(10):945-50.
Zhao Z, Sebastian A, Larsson L, Wang Z, Zhang Z, Norback D. 2008. Asthmatic symptoms among pupils in relation to microbial dust exposure in schools in Taiyuan, China. Pediatr Allergy Immunol 19(5):455-465; doi: 10.1111/j.1399-3038.2007.00664.x.
Zock JP, Jarvis D, Luczynska C, Sunyer J, Burney P. 2002. Housing characteristics, reported mold exposure, and asthma in the Ruropean Community Respiratory Health Survey. J Allergy Clin Immunol 110(2 Pt 1):285-92.